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ADJECTIVES OF COLOR IN INDIAN LANGUAGES.

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SCIENTIFIC inquiry into the cause and frequency of partial and total color-blindness among civilized nations has prompted some naturalists to extend their researches on this deficiency and on the sense of color (the faculty of color perception) over the rude populations inhabiting foreign lands. Inquiries of this order may be considerably helped by publishing all the terms referring to colors found among Asiatic, African, American and Polynesian nations and tribes, and they have been advanced already through careful comparisons of the color adjectives in use among the ancient Greeks and Romans with those of modern European languages.

Indians possess a large number of color adjectives, and the great tendency of their languages to specialize every object observed easily accounts for this. But it often requires a long familiarity with individuals of a tribe to obtain a series of color names approaching to completeness; some of these names are seldom used and therefore not readily remembered even by the most intelligent natives. I therefore resorted to the expedient of composing a scale of colored paper slips insensibly blending into each other; this series was arranged in several groups—gray, blue, green, yellow, red, brown, the end colors being white and black. To prevent confusion by presenting too many color-shades pasted on the same card-board, I have restricted the number of slips to twenty, and this seemed to be sufficient for the purpose. Simultaneously I inquired for the color-shade of certain objects unalterable in their color, as bark of cinnamon, ripe

strawberries, cherries, certain flowers, the yolk of egg, the rainbow and others.

The color series found in Indian languages and in the classic tongues of the ancients differ from ours chiefly by their great lack of *artificial* terms, though even there they are not entirely wanting. The curious and very frequent coincidence of green and yellow, and of blue and green will be considered below.

All Indian terms mentioned in this article are written by means of a scientific alphabet based on European Continental pronunciation.

Of no Indian language have I obtained a more complete color series than of the *Klamath language* of South-western Oregon, spoken by the Modoc and Klamath Lake (or É-ukshikni) Indians. I present this to students as a fair specimen of the idea of color prevailing among *such* Indian tribes which have but *recently* emerged from the nomadic and hunter state.

No abstract noun exists corresponding to our terms *color, color-shade* or *hue*. But there is a word for the substance used in the dyeing process, which also means dot, stain: shnéluash. It is the verbal noun of shnélua, to stain, to dye, to color, a verb which forms the participle shnéluatko, colored, dyed, and the substantive shneluō'tkish, dye-stuff, coloring matter. Shnélua is etymologically connected with shnélχa, to burn through something, the radix being núta, to burn (v. intr.). Other terms referring to colors and colored articles are: hushkalχanátko, of diversified colors; uyókatko, striped, streaked; shankákash, collar, beads or neckwear of various colors. Three different terms exist for *paint* put on face, arms or body.

For a full comprehension of the terms given below, it is necessary to remember that all the *real* adjectives of the Klamath language, descriptive of surface-quality and color, terminate in –li, and are formed by iterative reduplication, viz: by redoubling of the entire radix without vocalic change. The suffix -ptchi, –tchi means *alike to, similar, resembling;* it forms adjectives from substantives, mostly of a concrete, material signification. The suffix –tko is the sign of a participle, though the verbs, from which participles and verbal adjectives in –tko are derived, have sometimes become obsolete.

No distinction is made between artificial and natural *white;* both are pálpali, pä'lpäli, derived from pála, to dry up, to be exsic-

cated. *Gray* is päkpä′kli, a thematic variation from pä′lpäli, and related to the verb pä′ktgî, "the morning dawns," and to pä′ka, a kind of blanket. Various shades of *gray* are distinguished by these Indians, as lúashptchi, gray as fog (lúash, fog), käílaptchi, gray as earth, of earthy hue (käíla, ground, dirt, mud); skédshatko, gray, said of rocks, horses, etc.; spúgatko, gray-colored.

The common term for *blue* is mätchmä′tchli, metsmétsli; this is a dark blue, for obsidian arrow-heads are called by this adjective, and it also corresponds to our *purple* and *violet-colored*. Bluish-gray is mäkmä′kli, and this word we find also in the generic term for all water birds, ducks, etc.—mä′mäkli. A certain shade between blue and purple, applied to a sort of blanket, is tchẓe-utchẓé-uptchi, a nuance derived from the color of the bluebird, tchẓe-utchẓé-ush. Another shade of blue is called after a certain kind of beads, yámnashptchi (yámnash, i-ámnash, neckwear) and it is said also of a blue fire-flame.

The common Klamath term for *green* is käkä′kli, suggestive of the light or grassy green. Another green is tolalúptchi, green like the tólalui-blanket, which is manufactured from the tólẓash-grass.

The light and golden *yellow* is again käkä′kli. This adjective combines the meanings of light-green and light-yellow, because it stands for the color of any grass, weed or plant, and though the plant passes from the green of spring time and summer into the faded yellow of autumn, the color-name is not changed. But there is another term for the color of the dry leaves in the fall, spálptchi, derived from pála to become dry, spál, yellow earthy paint for the face. The light yellow of metallic gold and the dusky hue of copper are also called käkä′kli, but the *brown* shade of cinnamon is ka-uká-uli, the light-sorrel of horses and the shade seen on pine-burs. A shade darker than this cinnamon hue is tchuitchúili, *buff* or *dark sorrel*. Tchúitchiga means "to be at red or white heat," and tchúitchiks is "strawberry," a fruit called so from its ruddy color.

All the different shades of *red*, as scarlet, incarnate, crimson, carmine and vermilion, are comprehended in the adjective taktákli, while *blonde* (hair) is mákmakli (lák).

The generic term for absence of light is pushpúshli, *black*, which applies also to objects of nature, to complexion, etc. Dim, obscured, dusky-colored is tiptípli; dark-colored, limlímli, the

latter applying also to complexion of the human skin, while both originally referred to the dark hue of clouds. When speaking of night or evening, they use the term tch'múka, "it is dark, obscure."

That certain radicals undergo a slight vocalic or consonantic gradation in many of these color-names to indicate diversity of shade, is obvious. Such changes we observe in metsmétsli, mäkmä'kli, mákmakli; in pä'lpäli, pä'kpäkli; in käkä'kli and ka-uká-uli.

The idiom of the *Nez-Percés* is spoken by the populous Indian tribe of this name which inhabits the northern part of Idaho Territory. This language was adopted during the course of this century by the Cayuse tribe, on Columbia river, and belongs to the linguistic family of the so called Sahaptin, a Selish term of unknown signification. The other dialects belonging to this family are those of the Warm Springs, Walawála and Yumatilla, in Oregon, the Yákima, Klikatat and Palús, in Washington Territory.

In the Nez-Percé, as well as in the Klamath, the true adjectives of color are formed by reduplication of the monosyllabic radix, in the Nez-Percé, in some instances, even by redoublement of a dissyllabic root.

The term for *white* is also that for clear, transparent (said of *water*) ɣaíɣaiɣ, while light-gray, light-cream color is púɣpuɣ, or páɣpaɣ. A somewhat darker *gray*, or darker cream, drab or light-yellow is ka-uɣká-uɣ, also pronounced kä-uɣkä'-uɣ, ka-uká-u, and used for the metallic shine of silver.

The *blue* shades are all rendered by yúshyush, yúsyus, the light or sky-blue being mä'ɣkuts yúshyush (mä'ɣkuts, *light, clear*); the deep-blue, páyu yúshyush. In the same manner are the different shades of *green*, tsíɣtsiɣ, distinguished from each other, mä'ɣkuts tsíɣtsiɣ being bluish-green or pale-greenish. Tsíɣtsiɣ, for itself, means the green color of grass, and can stand for *grass*.

Another light-yellow, *drab* or cream color is shĕlú-shĕlu wákush (wákush means *resembling, alike to*), a darker shade of it, páyu shĕlúshĕlu; *dun*, as said of horses, is pä'tkuiki, a lighter dun, between the foregoing and kä-uɣkä'-uɣ, is tako-wákush. Dun-grayish, or mouse-colored, is lakólkoli, while mógsmogs, máɣsmaɣs is *auburn, sorrel*, and may be said of the yolk of egg, of the brown bear, of blonde hair. The name of the Indian who lately accompanied Chief Joseph on his trip from the Indian Territory to the East, is Tchútli móksmoks, "Yellow Bow."

Lilac is expressed by kúshka mítip, "similar to the mitip berry." This is a berry of lilac color, which grows in a corolla or sort of grape. *Brown*, rusty-brown, deep-brown is shukui-shúkui; *red*, reddish-brown, ilpílp, and this term also serves to express the color of the red cherry, the strawberry and the centifoil rose. *Dark-brown* is páyu ilpílp, and *black*, timúχtimuχ, when said of black cherries, the black bear, the complexion of the negro, but hiskétse, when used of the darkness of night.

The Indians of this race do not distinguish more than three colors in the rainbow, máχsmaχs, or *yellow*, ílpilp, or *red*, and yúshyush, or *blue*.

The *Kalapúya* race of Indians are the primordial inhabitants of the Willámet valley of North-western Oregon, and within the historical epoch were the masters of about three-quarters of this vast and fertile domain, the remainder being held by the intruding Moláles. They are subdivided into the Atfálati, Yámhill, Lukamáyuk and the Kalapúya proper on the western, the Ahántchuyuk and Sántiam on the eastern side of Willámet river, while the Yónkalla or Ayankē'ld lived on some creeks forming tributaries to Umpqua river. With the exception of the Yónkalla their dialects differ but little, and what is given below is taken from the Atfálati (Tuálati, Wápatu lake) dialect. For more than twenty years hence the Kalapúya tribes have lived in common on Grande Ronde reservation, Yamhill and Polk counties, Oregon.

In this language adjectives are always connected with some pronominal or predicative prefix, which I have retrenched in these quotations.

White is mó-u; *gray*, plótim; *blue*, pé-i ánkaf pawé-u; *purple*, túlĕlu; *green*, tónktĕχo.

Yellow, pé-i ántk pawé-u; *sorrel*, liblo, a term borrowed from Chinook jargon; *roan-colored*, sándĕli; *brown*, pû'dshnank túlĕlu, "not quite purple;" *red*, tchál, tchéllim.

Of metallic or *golden shine* or *color*, wéltchiăm; *multicolored*, of diversified colors, yä'mtchei; *black*, móyim.

The real meaning of these names could not be disclosed, since the intricate phonetics of this linguistic family render etymological inquiries singularly difficult. We cannot draw any other inference from this list, as it stands now, but that the colors seem as well specified as in English, and that only blue and yellow show close resemblance or identity in their names.

The *Michópdo* Indians of the Maidu race of Northern California, east of Sacramento river, live in a small settlement on the outskirts of the town of Chico. They call themselves Otakímma, because they dwell on the banks of Ótakim shéwi, their name for Chico creek, a small tributary of Sacramento river. Their dialect differs but little from that of the Eskenímma, or Indians on Butte creek, seven miles south of Chico, near Durham town.

The adjectives composing their list of color names begin in e- and end in -i, and the majority is trisyllabic:

white, ékoko, said of natural and artificial white.
gray, épupi; gray beads, épupi gúya.
blue, époti, sky-blue, purple and blue with a yellowish tinge; épotim pápaga, the yolk of egg.
green, ébali; green beads, ébali gúya.
yellow, edsíshi, edsíssi: brown, roan, dark-sorrel, buff, of metallic shine, edshíshim peso, gold, gold dollar, lit. "yellow dollar."
color of blue-tailed deer, esíwiti; blue-tailed deer, esíwitim búku.
color of black-tailed deer, émuli; black-tailed deer, émulim búku.
black, ekíli; also dusky, dark complexioned.
red, épapi; said of flowers, ants, beads, etc.
striped in colors, etü'düti; animals, etc.
dark, dusky, kaísiki; said of night.
light, clear, yokáki; said of daylight.

In this list we perceive that the term for blue gradually passes into that of yellow, and that of yellow into brown.

Like other Indians the *Dakota* race possesses a very complete scale of color names in its sonorous idioms. The dictionary of Rev. Stephen R. Riggs has furnished the terms of the subdialect of the Santee-Sioux, and the language of the other Sioux tribes differs but very little from it. I have rendered Riggs' pointed h by χ, and the nasal n, which is heard in the French *bon, loin, reins* by ng. All the principal color names possess a reduplicated form to mark intensity, and form denominative verbs.

No abstract term for our word *color* exists, though there is one for *to paint*, owa, and others for *dyeing* and *painting* in any of the principal colors.

White is rendered by ska, to whiten by skaya, while sang means whitish, yellowish, brown, and ska also possesses the meaning of clear, transparent. The terms for *gray* designate a

mixture of black upon a white ground, or black mixed with white, as is visible in the skin of the badger, χa, oχa, oχaka; χota means not only gray but also brown, like sang (sangyang, to make brown or whitish). *Brown* is also expressed by gi, when it is a dark gray or rusty-looking brown; its reduplicated form, gigí, meaning *rust* and *brown, rusty*; gitká, brownish; gitkádang, a little brownish; gitkátka, reddish, brownish, yellowish. The g in all these words is a deep sonant guttural.

To, reduplicated toto, is *blue* and *green*, and all the intermediate shades; to color, dye, blue or green, tóya; blue and green beads, totódang. Purple, grape-colored is stang; purple, stangka; ha stáng, dark complexioned (ha meaning *skin*); shástang, dark red, literally "red-purple."

Yellow is zi; to dye or color yellow, zíya; the reddish-gray squirrel, zitchá. *Light red* is distinguished in this color by a separate term, sha, from *dark red* or scarlet, crimson; duta, which can also be rendered by sha χingtcha, or by deep, intensive red, shashá; to dye red is sháya, shasháya, and vermilion color or red paint is washé-sha; wasé being "red earth."

Dark is tpaza; darkness, to be dark, okpaza, otpaza. *Black* is sápa; deep black, sapsápa; to blacken, samyá; dark or blackish, samyáhan.

The words for whitish, red and black, sang, sha, sapa, seem to have been formed from the same radix, and this may be said also of the terms for white and black in the Atfálati-Kalapúya.

The *Sháwano* or *Shawnee* tribe forms a branch of the widespread Algónkin race of Eastern Indians, which is so intimately connected with the early history of the Colonies of North America. As their name indicates, they once belonged to the southernmost tribes of that family, and are now settled to the number of about seven hundred individuals in the north-eastern portion of the Indian Territory.

They have special terms for each kind of *body paint*, f. i., hú'lamu, red paint, which was the war paint, but no abstract term for *color*. I paint myself is netasathú, and the paint, hat'thika.

White is waχkanagiá; *transparent*, sápune. *Gray* is wípegua, and this may be modified, like any other color, by the adverbs pkúni wíbegua, *dark gray*, and hálawe wipegua, *light gray*. For *blue* and *green* only one term, skípagia, exists, this being used, for instance, of the color of the sky. *Yellow* is huthάwa; *red*

mskuáwi; *bronze colored* hálawi mskuáwi (lit. "light red"); *brown*, pkúni mskuáwi, or dark red, while the red cockscomb is mskuá pelué. No special term exists for *buff* color. *Black* is mkatéwa, and *opaque* is circumscribed by "you cannot see through." Objects *reflecting* sunlight are called waséte; multicolored, tsági yelatégi, and striped in colors, lalatasáte, when the stripes run in a vertical direction.

The *Creek* language is one of the dialects of the Maskōki linguistic family, once the form of speech dominant in the territories of the Gulf States. The languages forming this stock have, in course of time, differentiated so much among themselves that they have become incomprehensible to each other. The principal dialects, as far as known to us, are Chá'hta with Chikasa; Creek (upper and lower) with Seminole; Natchez; Hitchiti; Apalache. Nothing certain is known concerning the Alibámu dialect, which is still spoken in one of the south-eastern counties of Texas. Besides a few Indians remaining in Texas and in the Everglades of Florida, all the natives speaking Maskōki dialects are now settled in the Indian Territory.

The phonetic character of all these idioms pleasantly affects the ear accustomed to European languages. All of them, the Creek not excepted, possess the lingual s, which could be rendered by *thl*, a group of sounds approaching closely to its real articulation.

The term for *white* and *clear* is hátgi, and since every adjective of color forms an attributive verb, *he is white* is hátgis. From hátgi is derived supák'hatgi, *gray* and *roan*, literally, "mixed in with white."

Blue is holáti, ozoláti, which may be said of the sky, of water, of distant mountains; wíwat hulátis, the water is blue. *Green* is láni, and when said of plants it means "not in a dry state;" pahilánoma, grass-green; páhit lánis, however, means as well, "the grass is green," as "the grass is faded, yellow;" láni also means *bile*.

The term for *red*, tcháti, also means "blood," and forms the derivate oktsádi, *purple* (and *sorrel* when applied to horses).

Hásti, *black*, forms the derivate okulóshti, *brown; dark*, when used for the darkness of night, is yĕmúdshki.

Instead of inventing new terms for metals recently imported, as a few tribes have done, the Creeks will call gold coin, "yellow

iron beads," tchătu ɣónap láni; silver coin, "white iron beads," tchătu ɣónap hátgi; sulphur or brimstone is to them, "yellow gunpowder," tĕhótop láni; copper, brass and bronze, "yellow iron," tchátu láni; alum, "sour iron," tchătu kamúksi.

In the present article I have rejected all information that was not circumstantial and entirely reliable. In six languages I have relied on oral information gathered by myself, while for the Santee-Dakota, the words mentioned were extracted from Riggs' Dictionary. To draw *general* conclusions upon the subject of color nomenclature and the Indian perception of color from the few instances given here would certainly be precocious. Indian tribes show considerable difference from each other in habits, customs, intellectual power, not less than in their bodily qualities and in language. Hence very few general ethnological truths can be uttered about them that will really apply to them all.

The following *conclusions* are, therefore, intended to apply *only to the seven idioms referred to:*

1. In the lists of colors submitted we find that the Indians in question distinguish as many, if not more *shades* of color, as we do, if we exclude the large number of our artificial color-names, as ultramarine, isabelle, solferino, etc.

2. No generic term for our word *color* exists, and it seems that such a term is too abstract for their conception. But they have terms for coloring matter, dye-stuff, paint, and for our participles "colored," "dyed," "painted" and "tinged."

3. Many of their colors, even the most opposite ones, are derived from one and the same radical syllable. Instances were given under Klamath, Kalapuya, Dakota. The same may be observed when we compare our blank, blue, black and the German bleich (livid, pale); gray and green.

4. In the Indian lists we observe some names of medley or mixed colors, which impress the eye by being not homogeneous. Such is the Klamath mä'kmăkli, which is the blue mixed with gray, as observed on wild geese and ducks; tchɣe-utchɣé-uptchi, the mixed color of the bluejay; and gray, in most of the dialects, means black mixed in with white, or white with black, as observed in the fur of the racoon, gray fox and other wild beasts.

5. In naming some colors Indians follow another principle than we do, in qualifying certain objects of nature by their color and then calling them by the same attribute, even when their color

has been altered.[1] This we distinctly observe in käkä'kli, *yellow* and *green* in Klamath, the adjective having been given originally to the color of grass, trees or other plants. The same is observed in the Niskualli language of Washington Territory, in which both colors are called hókwats, and we may assume that this is the light and not the dark shade of yellow and green.

Most frequently *blue* and *green* are rendered by one and the same term, as in Dakota, Sháwano and in Maya (yáash). Other Indian dialects which are reported to have the same name for both colors are the Chokóyem, north of San Francisco bay: sivita; the dialect of the Yákimas and Warm Spring Indians of Sahaptin family, lómĕt, lă'mt; the Shásti, itchumpaẓé; the Guarani, tobi; and the Muyskas near Bogotá, chiskuiko, the latter belonging both to South America. Among the Paí-Uta, the Uta, Pomo, the Wintún and the Tinné-Apaches, the terms for both colors seem to be identical also. Unfortunately we are not acquainted with the etymology of all these terms, unless we would probably be enabled to prove that the real cause of this curious coincidence is another than color-blindness.

Blue and *purple* is called by the same name in Klamath and in the Michópdo dialect of Maidu.

Red and *yellow*, or *yellow* and *brown*, or *brown* and *red* are sometimes expressed by the same term, but *only when yellow* and *blue* are called *differently*. I have never met with a dialect which called black and dark blue, or black and dark green by the same adjective, though this is reported to be the case among the Niskualli, the Ta'hkali of British Columbia, and several other tribes.

6. As I have stated above, Indians often follow principles differing from ours in naming colors. The Klamath language has two terms for green, one when applied to the color of the vegetals (kakä'kli), another when applied to garments and dress (tolalúptchi). Blue when said of beads is again another word than blue in flowers and blue in garments. Thus may be explained the fact that some investigators have found the adjective *black* attributed to objects of a dark-blue or dark-green color. The Dakotas have three terms for brown, gi, sang and ẓota, each of them being applied to objects of different classes. Even in

[1] Thus the name applied to the color of a quadruped may remain even when the animal has changed its color through the change of seasons.

English we use different terms when speaking of the darkness of night and the black of a dress; or of the blonde hair and the yellowish-white corresponding color of other objects striking our eye-sight. The occasional existence of more than one term for *one* color for the reason just alluded to is observed in the languages of every portion of the globe. Curiously enough the *red* color is not often diversified into different shades in the languages considered; in Spanish it is colorado, "showing color;" this evidently means that red is the color striking our eye with the greatest intensity.

7. Reduplication of the radix is very often met with in color names, but the cause of this is not always the same. In Klamath and the Sahaptin dialects it is distribution and repetition, in Dakota it is the idea of intensity that has produced this synthetic feature.

We think the inquiry into the color-sense and that into the color-blindness among the individuals of a people must be kept distinct from each other. It is premature to assume that a whole people can be color-blind, though its color nomenclature may largely differ from ours, but it is by no means improbable that color-blindness is more frequent among hunting and nomadic nations than among individuals of civilized races. This question can be decided by direct experimental observation only, while in the inquiry concerning color-sense, the science of linguistics is entitled to take part in the discussion.

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THE HABITS OF A TARANTULA.

BY MRS. MARY TREAT.

FOR the past year I have been observing a large burrowing spider belonging to the family of Lycosidæ. Its habits and probably the creature itself, had entirely escaped the attention of naturalists until recently. Its habitat is in Southern New Jersey. In the grove which surrounds the house where my observations were made, are many burrowing spiders which build open tubes lined with a web of silk, and a projecting rim of sticks and leaves are firmly held together with web to keep the sand and *debris* from falling into the nest.

Last summer (1878), I accidentally found a covered tube, perfectly concealed, which aroused my curiosity sufficiently to keep

close watch of the occupant. I did not pay much attention to the open-mouthed tubes for some time, as I supposed the occupants to be a distinct species from the one which covered the tube.

In July of last summer the Rev. Dr. McCook, of Philadelphia, the distinguished myrmecologist, upon invitation, visited my colony of slave-making ants (*Formica sanguinea*), and while on this visit I called his attention to the burrowing spider with the open tubes. After his return home he wrote me that he thought the spider a new species which he had provisionally named *Tarentula tigrina*,[1] or the tiger spider. But the spider with the covered tube was of so much more account that I still paid no attention to this one which lived in the open burrow! But I am now convinced, after a year's observation, that what I supposed to be two distinct species are but one. The young scarcely ever conceal their tubes.

A brief account of one individual spider will, perhaps, give a clearer idea of this species than any attempt at a learned disquisition. A large female has her home in a bed of moss beneath an oak tree, only a few feet from the house. Her body is nearly black and quite hairy, the legs are gray and black, striped after the fashion of a tiger. When I first observed her the tube was only partially covered, the cover projecting above it like a hood or top of a baby carriage. When not disturbed, she usually stood at the door of her home waiting for any chance insect which she might spring upon.

My visits to her were very frequent, and for several days upon my approach she would suddenly disappear within her den, but finally she seemed to become accustomed to these visits and would allow me to sit near her, keeping her position at the door. I supplied her with water, of which she would take long draughts. I also placed sugar near her door to attract the flies. She would stand perfectly motionless, watching the eager insects, until she fixed her eyes upon one that suited her taste when she sprang upon it like a flash, and disappeared within her den to make her meal. This kind of life continued for several weeks—simply watching for prey and eating. But in August another phase in her life was made manifest. A male was attracted to her cozy quarters. He does not look at all like the female, is of an entirely

[1] Proceedings of the American Entomological Society, 1878.

different color—yellowish with dashes of dark brown—his body is smaller than hers though his legs are longer.

In August the males are abundant. I often see them bounding over grass and weeds, making long strides, fairly flying before me. At such times it is next to an impossibility to capture one. I have not been able to ascertain whether he has a settled home like the female, which he leaves to make amorous visits, or whether he always leads a vagrant kind of life.

He approaches the female with the utmost caution. If she is within her den he stands at the door, sometimes hours together; nothing will induce him to venture within, and he is wonderfully oblivious of my presence. I cannot push him in, he will back out into my hand rather than be driven into the burrow. Now the female slowly advances to meet him, and he slowly retreats from the mouth of the den, moving backward while she moves forward, just reaching him with the tips of her fore-legs as if caressing him. She follows him in this way a foot or more, then leaves him and quickly returns to her den, he follows her to the door, where he keeps his post until she again comes forth, when the same performance is repeated.

I leave them, and on my next visit I find the male on the back of the female, with their heads both within the burrow and their long hind-legs sticking out. (This is not the position the spider assumes when he fertilizes the eggs, which is done by means of the palpal organs, necessitating the opposite direction of the head.) They now remain perfectly still, and I pick them up by their legs and drop them into a wide-mouthed glass bottle. This displaces the male, and he crouches down in a helpless sort of way as if paralyzed with fear, not trying to make his escape at all. For a few moments the female pays no attention to him but makes vigorous efforts to escape. Soon, however, she pounces upon him, seizing him on the under side of the head—literally by the throat. He makes but feeble efforts of resistance, in fact, acts as if he rather enjoyed being eaten! I shake the bottle but she will not let go her hold. She soon makes him into a ball which she holds and sucks, seemingly with great relish. I now place the open bottle by the mouth of her den and she quickly disappears, taking with her the remains of her lover. In a day or two after this another male was at her door behaving in a similar manner. I did not interfere with his movements, and do not know his fate.

After a few days the female resumed her old habits, watching for prey, and became so tame that she would take water from my hand. She made but little change to the partial cover of her tube until November, then it was cut down and made flat to the ground—perfectly concealed with leaves and moss and held firmly down with a strong web. This cover remained until the following April. I was waiting to see what the occupant would do, when an accident occurred. I was absent when the leaves were raked up, and the man, not observing my protection, raked all away. But in a few days thereafter the spider made another cover, entirely unlike the winter one, more like a little room. The nest is situated in a bed of green moss, and the cover looks like a little oval mound of moss and leaves. The longest diameter measures five inches over, and the shortest, four and a half inches. The base of the cover is made of acorn cups and sticks firmly held together with strands of silk, then a canopy of web is made, and over this is laid green moss, dry pine needles, bits of dry oak leaves and light sticks held fast with web. This makes a neat little upper room, the walls are smooth on the inside but rough outside. She leaves a window in the room, the object of which is apparent. She has a cocoon of eggs attached to the spinneret, and she puts herself in position to let the cocoon rest against the window where it receives the rays of the sun. For three weeks this has been her daily occupation—patiently holding the eggs in the sun.

On the 20th of May I took the cover from the tube and after it was removed it was some hours before I saw her, but toward evening she reached out with her hind-legs; feeling for material, she first drew in an acorn cup and proceeded to fasten it. How it was

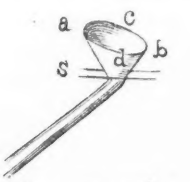

FIG. 1.—*s*, surface of ground; *a b c d*, silk-lined tunnel.

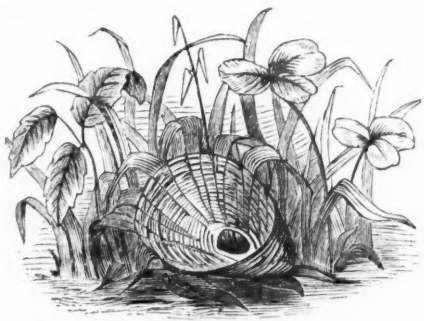

FIG. 2.—Nest of *Tarentula tigrina* (?).

done I cannot tell, for the cocoon of eggs seem to be attached to the spinneret. On the following morning a broad funnel-shaped rim was built around the tube but not yet covered; by the 24th she has made a room lightly covered with moss.

Rev. Dr. McCook kindly furnished cuts of the nest with the open funnel. I append his description, which was published in the Proceedings of the Academy of Natural Sciences of Philadelphia: "The tube is about seven and one-half inches deep, resembling an ear-trumpet (Fig. 1), with the mouth upward. It is bent at an angle of 60° shortly below the surface; the upper part is a silk-lined funnel that widens outwardly to the margin which at the highest point is one and one-eighth inches above the surface of the ground. The silken lining extends but a little way below the surface. The projecting funnel is composed of blades of grass (Fig. 2), which are bent down upon their stalks from all sides, overlaid, and rudely interwoven, making thus a background upon which the smooth silken lining is placed. The longest diameter of the mouth of the tube (Fig. 1), *ab*, is one and one half inches, the shorter diameter *cd*, is one and one-quarter inches. The diameter of the tunnel below the surface is five-eighths of an inch."

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THE FORMATION OF CAPE COD.[1]

BY WARREN UPHAM.

THE peninsula of Cape Cod, called by Thoreau the "bended arm of Massachusetts," the Elizabeth islands, which are a continuation from it to the south-west, and Martha's Vineyard and Nantucket on the south, are recent additions to the territory of New England. They contain no ledges of solid rock, but are made up of the ruins and detritus of ledges which have been broken and pulverized. This has been done by decomposition under the influence of frosts and rains, by the excavations of

[1] A previous description of this region, based on observations made in a hasty journey for comparison of its drift deposits with those found in New Hampshire, was presented a year ago in the Geological Report of that State, Vol. III, pp. 300–305. Since that time the writer has been over this field more leisurely, spending several months in amateur exploration from Cape Cod and Nantucket westward to New Jersey. This has brought a more correct knowledge of the facts, especially in respect to the course, in South-eastern Massachusetts, of the series of hills here called terminal moraines; as well as some changes in opinions, one of these being in respect to the probable height of the sea here when these deposits were accumulated.

streams, and at the last by glacial erosion. Materials have been thus gathered and mixed from sources near and remote. Their deposition, excepting the Tertiary beds of Martha's Vineyard, appears to have taken place during the Quaternary period, partly before the ice-sheet was extended over this region, partly along its terminal front in long series of morainic hills bordered on the south by sloping plains of gravel and sand, and partly by immense floods poured down from the surface of the melting ice-fields during their retreat.

Since the glacial theory of the origin of the drift was brought to the attention of geologists by Agassiz, forty years ago, it has been closely compared with all the observed facts, and seems to afford for them an adequate and complete explanation. It has received the highest kind of testimony to its truth in being required to explain new discoveries and to answer questions which were not thought of when the theory was announced. The glaciers of Switzerland were found to furrow, scratch and polish the bed-rock over which they move, rounding and planing away its projecting points, just as the ledges of all northern countries are striated, rounded and worn smooth. This is done by the grating of boulders and gravel frozen in the bottom of the ice; and the sides of these stones are, of course, planed and striated the same as the underlying rock. In the valleys of the Alps are many glaciers ten to twenty miles long, and through this whole distance rock-fragments are dropped on them from bordering cliffs, brought in by tributaries and wrenched from the ledges beneath; so that diverse kinds, some of them derived from its farthest sources, become mingled both at the top and bottom of the ice. Corresponding to this transportation, grinding and mixture of materials effected by the glaciers, there was found over the surface of all regions which had striated ledges a most remarkable deposit of boulders gathered from distant and diverse sources, indiscriminately mixed with gravel, sand and clay. Many of these blocks and pebbles have their sides worn flat and marked with striæ, and were evidently the agents by which the ledges were similarly eroded and marked. This deposit, called unmodified drift or till, differs from any made by rivers, lakes or the sea, in showing no evidence of the assorting and stratifying action of water. To account for its formation and for the accompanying striæ on the ledges, it was supposed that a mantle of solid ice was accumulated

over these areas, and that it moved slowly in the direction of the striation, ploughing up, transporting, grinding and mixing together the materials of the till, and leaving its track and course clearly marked upon the bed-rock.

Cape Cod is mainly composed of another formation, called modified drift, because it has been transported, worn and deposited by currents of water. Gravel, sand and clay are separated in distinct layers and beds, instead of being mingled in one mass. Most portions are entirely destitute of any large boulders, and the pebbles of the gravel are rounded, instead of the planed or else rough and unworn forms which they have in the till. The modified drift is found in the valleys or upon the nearly level tracts of glaciated regions, and follows lines of drainage which reach beyond these limits. Formerly it was the prevailing opinion that this formation was gradually produced from the unmodified glacial drift by the ordinary action of rains, streams and the sea. Further observation, however, seems to leave no doubt that it originated from the ice-sheet, and was rapidly deposited during its retreat. This had taken up in its lower portion not only boulders of every size, but also great quantities of decomposed rock, which covered the hills and plains and had been swept into thick deposits in the valleys before the glacial period. The rivers formed by its melting gathered such of these materials as they could transport, turned the blocks and pebbles over and over in their descent till they were made round and smooth, and deposited their freight in these beds of gravel, sand and clay. The modified drift of South-eastern Massachusetts, here to be described, appears to add much to our knowledge of these conditions attending the departure of the ice-sheet.

Another subject of great interest is presented on Cape Cod and the Elizabeth islands in a series of drift-hills, which appear to have been formed at the margin of the ice during a pause in its retreat, when, perhaps after some re-advance, it halted and preserved its termination nearly stationary through a long period. This series consists of very irregular hills, mounds, ridges and enclosed hollows, and is composed partly of till, with abundant boulders and no marks of stratification, and partly of stratified gravel and sand with boulders few or rare. That it does not indicate the extreme limit of glacial action is shown by the occurrence of a similar belt of hills on Martha's Vineyard and

Nantucket islands, from five to thirty miles farther south. A comparison of these with similar ranges of hills in Rhode Island, Long Island and New Jersey, which seem to be same series continued farther to the west, will enable us more fully to understand the meaning of these deposits.

The most noticeable product of a glacier is its terminal moraine, or the heaps and ridges of detritus which it brings down and pushes out at its end, when this remains at nearly the same place through a long succession of years. Slight advances and retreats often give these deposits a most broken surface of alternating hillocks and depressions, and in many cases they are partly composed of stratified gravel and sand, brought by streams during the meltings of summer. The great ice-sheets of the glacial period acted in the same way, and within a few years geologists have recognized the terminal moraines of that which overspread the Northern United States and British America. Across New Jersey[1] and upon Long Island[2] its outmost border is definitely marked by a continuous series of drift-hills, one hundred and seventy-five miles in extent. Striæ, till and boulders are confined to the region north of this line. From the Narrows to Montauk point this moraine is commonly known as the "backbone of Long Island," and consists of hills which vary from one hundred and fifty to three hundred and eighty-four feet in height. The west portion of this range, reaching from Fort Hamilton, by Greenwood cemetery, Prospect park and Ridgewood reservoir, to Roslyn, a distance of twenty-five miles, is mainly an unstratified deposit, like the loose, oxidized, angular upper till which forms the surface generally through New York and New England. From Roslyn, through the middle and east portions of the island, nearly all of these hills, including the highest elevations in the range, are composed of modified drift, being gravel and sand distinctly stratified and containing few or rare boulders. The part of Long Island south of these hills consists of gently sloping plains of fine gravel and sand, five to ten miles in width, and extending a hundred miles in length. The height of their upper margin at the foot of the hills varies from fifty to one hundred

[1] Annual Report of the Geological Survey of New Jersey for the year 1877, pp. 9–22, with map.

[2] This series of hills on Long Island was well described by Mather in the Geological Report of the First District of New York, in 1843, shortly after the theory of continental ice-sheets was proposed.

and fifty feet above the sea. Another long series of plains, varying from one mile to five miles in width, and of similar height and southward slope with the foregoing, extends on the north side of these hills from Syosset forty-five miles eastward to Riverhead, and thence continues along the north branch of the island nearly thirty miles more to Orient point. North of these plains, along the whole extent of shore east from Port Jefferson, is another series of drift-hills which rise one hundred to two hundred feet above the sea, by which their northern side has been frequently washed away. This second moraine is also mainly composed of stratified gravel and sand with few boulders; but in the vicinity of Greenport and Orient its material is changed to a very coarse unstratified deposit like the upper till. This series is very plainly continued north eastward in Plum and Fisher's islands, which are made up of hills of glacial drift like those near Greenport, with small areas of level modified drift at their south side. Thence it passes into Rhode Island at its south-west corner, and extends close to the coast seventeen miles from Watch Hill nearly to Point Judith, being very finely developed in a belt which varies from one-half mile to one and a-half miles in width, composed of coarsely rocky drift in hills and ridges one hundred to one hundred and fifty feet high. About two miles north-west from Point Judith this range sinks to the sea-level, and its further continuation is lost, probably because it turns southward into the ocean. Twelve miles to the south the continuation of the first range is lifted into view in Block island, a knot of very irregular drift-hills, which resemble those of Montauk in being composed of coarse gravel, sand and clay, distinctly stratified but often enclosing numerous boulders. We have thus two long parallel series of drift-hills, the most southern of them at the boundary of the glacial drift. Both appear to be terminal moraines of the ice-sheet, having been formed along its border, the southern range at its period of greatest extent, and the northern at some later time during which it halted in its departure.

The sea covers the next thirty miles in the line of continuation of these series of hills, beyond which both of them rise above its waves again, the northern forming the Elizabeth islands, and bending to the north-east and north on the peninsula of Cape Cod to near North Sandwich, where it turns at a right angle, and thence runs to the east through Barnstable and the other towns to Orleans,

traversing the west-to-east portion of the cape, and extending into the ocean at its east shore. The southern moraine, marking the farthest bound reached by the ice, forms No Man's Land, the crest of Gay Head, and prominent ranges of hills in the north-western part of Martha's Vineyard, extending north-east nearly to Vineyard Haven. Here this series apparently bends to the south-east, somewhat as the northern range turns at North Sandwich, but it is concealed beneath plains or the sea for much of the way beyond this point. It appears unmistakably, however, on Chappaquiddick and Tuckernuck islands, and in Saul's hills and Sankaty Head on Nantucket. The length of the northern moraine from the east shore of Cape Cod to the west end of the Elizabeth islands is sixty-seven miles, while its total length to Port Jefferson, on Long Island, is about one hundred and eighty miles. That of the southern moraine, in its course from Sankaty Head to No Man's Land, is fifty miles, and its whole extent as yet traced, to the west line of New Jersey, is about three hundred miles.

On the islands south of Cape Cod these hills have the following heights in feet above the sea: No Man's Land about one hundred and fifty; Gay Head one hundred to one hundred and forty-five; about one mile east, near the church, one hundred and eighty-five; Prospect hill, the highest on Martha's Vineyard, two hundred and ninety-five; Peaked hill, a mile south from the last, two hundred and ninety; other hills, reaching from these five miles to the north-east, two hundred to two hundred and fifty; Indian hill, two hundred and forty-five; Sampson's hill, on Chappaquiddick island, about one hundred; highest part of Tuckernuck, about fifty; Macy's or Pole hill, the highest of Saul's hills, ninety-one; Folger's hill, a mile east from the last, eighty-eight, and Sankaty Head, the highest point of Nantucket island, one hundred and five. The cliffs of Gay Head, at the west end of Martha's Vineyard, expose a section four-fifths of a mile long, composed at the top of the unstratified terminal moraine five to forty feet thick, filled with abundant boulders of all sizes, up to twenty feet in diameter. This rests on fossiliferous Tertiary beds,[1] probably of Miocene age, which dip from 20° to 50° northerly throughout the section, and present a most striking succession of brightly-

[1] Described in Hitchcock's Geology of Massachusetts, 1833 and 1841; and in Lyell's Travels in North America in 1841-2, Vol. I, pp. 203-206.

colored clays, sand and gravel, varying from black to red, brown, gray and white. Gay Head township, reaching three miles to the east, has a very uneven surface of glacial drift in small elevations and depressions, strown with frequent boulders but apparently underlain by Tertiary clay and sand at no great depth. The parallel ranges of hills which extend through Chilmark and the north-west part of Tisbury, occupying a width of one to three miles, have also a very irregular contour. Their surface is generally glacial drift with very abundant boulders, but occasionally, as at the top of Prospect hill, it is modified, consisting mainly of water-worn gravel and sand. The black, red and white Tertiary clays underlie these deposits in the hills, and are exposed in the cliffs along the north-western shore to the east side of Lumbard's cove, eleven miles from Gay Head. Upon the south side of Prospect and Peaked hills they extend to heights two hundred and twenty-five and two hundred and fifty feet above the sea.

The south-eastern half of Martha's Vineyard consists of modified drift without boulders, lying in extensive level plains twenty-five to fifty or sixty feet above the sea. Along the south shore these plains are indented by numerous ponds, which are only separated from the ocean by a beach, and the shores of the ponds are again indented by long and narrow arms or coves, from the head of which dry channels extend across the plains in a northerly course. The road from West Tisbury to Edgartown crosses several of these depressions, one of which, known as Quampachy hollow, may be taken as an example; this starts from the head of Oyster pond, a narrow arm of the sea which stretches two miles north from the beach by which it is now shut in. The dry hollow, diminishing from twenty-five to ten feet in depth and from three hundred to one hundred feet in width, prolongs this valley at least three miles to the north. Near Vineyard Haven and Oak Bluffs, north of these plains, and on Chappaquiddick island, the modified drift, sometimes sprinkled with boulders, is heaped in gently-sloping hills fifty to one hundred feet high, which appear to have been formed at the margin of the ice-sheet. Thence the line of terminal moraine is continued in Muskeget and Gravelly islands, which, however, are only low banks of gravel and sand. On Tuckernuck island it appears again in small hills, which in part, as seen at North pond and eastward, are unstratified, with plenty of boulders, the remainder being modified drift.

Nantucket is almost wholly composed of stratified gravel and sand. Along the whole south side of the island, from Long pond to Tom Never's Head, these lie in nearly level plains, twenty to sixty feet above the sea. This expanse, reaching more than ten miles from west to east, with a width varying from one to three miles, is broken by frequent hollows which extend approximately from north to south like those already noticed on Martha's Vineyard. Narrow ponds, of the same height as the ocean, fill the entire course of these depressions, or occupy their lower end next to the beach. All the ponds along the south shore are of this class, including Long, Hummock, Miacomet, Weweeder, Nobadeer, Madequecham, Wigwam and Forked ponds, with several others of smaller size. The line at which the ice-sheet appears to have terminated is marked in the west part of the island by gently undulating hills, forty to fifty feet high, composed of stratified drift, which, however, differs from that of the plains in having here and there boulders up to ten feet in diameter embedded in it or lying on the surface. The course of this line is from Eel point, north of Maddequet harbor, by Trot's hills, to the town. Eastward it continues on the same course in the Shawkemo hills and Saul's hills to Sankaty Head. The portion of this series called Saul's hills, two miles long and a half mile wide, is of very irregular contour, with steep and abruptly-changing slopes, forming hills, ridges, mounds and small enclosed basins, some of which contain ponds. The material is stratified gravel and sand, upon and in which are scattered boulders, varying up to ten feet in diameter.

Sankaty Head, at the east shore of the island, affords a section across this range.[1] A quarter of a mile south from the light-house, the order of deposits, beginning at the base, is as follows: brown sandy clay to about twenty feet above the sea; ferruginous sand and gravel, four feet; white sand, four feet; yellow sand, enclosing masses of blue clay, one foot; ferruginous gravel and sand, with abundant shells, two feet; a bed of Serpulæ mixed with sand, about two feet; gravel and sand again, thickly filled with shells, two feet; fine white sand, about ten feet; the common yellow sand and fine gravel of the modified drift, about forty-five feet, its top being at ninety feet;

[1] The Post-pliocene beds at the base of this section, and their fossils, are fully described by Prof. A. E. Verrill and Mr. S. H. Scudder, in the *American Journal of Science and Arts*, 3d series, Vol. x, pp. 364–375.

coarse gravel, three feet; ferruginous sand, one foot, changing above into a former surface soil one foot thick; overlain by three feet of dune sand, which forms the present surface ninety-eight feet above the sea. The highest part of the bank is midway between this point and the light-house. On each side of the section here noted the shell-beds gradually thin out and disappear at a distance of about forty feet. The bed below the layer of Serpulæ contains about thirty-five species, which make up a faunal group of distinctly southern character, all of them being now found living on the southern shores of New England, but several having their northern limit at Cape Cod. The species of Serpula is also of southern range, reaching from this limit to North Carolina. The upper shell-bed has about the same number of species as the lower, but only thirteen are common to both. The new species brought in by the upper bed are mostly of northern range; though all of these are found as far south as Massachusetts bay, several of them have their southern limit here or on the south coast of New England. From a comparison of these groups, Prof. Verrill estimates that the average temperature of the sea at this place had been lowered 15° between the times in which they lived. The layer of coarse gravel which occurs here at the height of ninety feet, is continuous for a half mile from this point, both to the north and south, varying from three to eight feet in thickness. About half of its rock-fragments are rounded, these being of all sizes up to one foot through; the rest, which are rough and angular, range up to two feet and rarely to four feet in diameter. This bed has its greatest thickness and is coarsest at the highest portion of the bluff, where it closely resembles till. The old surface of black soil and the present surface of dune sand are also continuous along the same distance, the latter at the light-house and northward being one and a half feet thick. An eighth of a mile south from the shell-beds the bluff falls to a hollow about sixty feet above the sea, and in this depression the blackened layer becomes a bed of peat two feet thick, containing numerous stumps and roots of trees and covered by two feet of sand. The rocky stratum, the old surface soil and the overlying sand cap the bluff for more than a mile, in which its height falls from one hundred and five feet at the middle to about thirty-five feet at each end. Below the rocky layer it consists of fine modified drift and pre-glacial beds. The his-

tory of this section reaches from a period when the sea had about its present temperature; next it becomes much colder; sand and fine gravel are accumulated to a depth of more than fifty feet, probably brought by rivers from the summer meltings of the ice-sheet; this finally reached its outmost limit, overspreading the north half of the island; at its retreat the coarser materials which it held were dropped; forests sprang up as the climate became mild again; and lastly, the sea has eaten away the east portion of these deposits, while the sand of its shore has been swept by the wind over their top.

Heights of the later terminal moraine, on the Elizabeth islands and Cape Cod, are as follows; highest portions of Cuttyhunk, Nashawena, Pasque and Naushon islands, about one hundred and seventy-five feet above the sea; the Quisset hills, west of Falmouth village, about one hundred and fifty; station of the U. S. Coast Survey, one mile east of West Falmouth, one hundred and ninety-eight; the Ridge hills, extending thence to the angle of this series near North Sandwich, one of them being called Pine hill on the State map, one hundred and fifty to two hundred feet; south-west from Sandwich village, about two hundred and twenty-five; Bourne's hill, a Coast Survey station two miles south-south-east from Sandwich, the highest point of the whole series, two hundred and ninety-seven; the Discovery hills, including the last and extending eastward, two hundred and fifty to one hundred and fifty; Shoot Flying hill, one-half mile north-west from Great pond in Barnstable, about two hundred; German's hill, in Yarmouth, one hundred and thirty-eight; Scargo hill, in Dennis, one hundred and sixty-six; railroad summit at Brewster station, one hundred and twenty-five, and Mill hill, in Orleans, about one hundred and fifty.

This moraine forms the entire chain of the Elizabeth islands, fifteen miles long with an average width of one mile. Their contour throughout is very irregular, with no well-marked trend of the elevations, which are roughly outlined hills and ridges of variable height, enclosing many crooked and bowl-shaped hollows which often hold small ponds. Their material is glacial drift with abundant angular boulders of all sizes up to twenty or thirty feet in diameter. In a few places this unmodified till was seen enclosing or passing into stratified gravel and sand. The surface exhibits all the characteristic features of the upper till,

being loose, yellowish in the color of its detritus, and with its boulders almost invariably angular except as they have been rounded by exposure to the weather. This deposit also appears to form the greater part of the cliffs upon the shores of these islands. At the north-east end of Naushon, however, in deepening an old well, from forty-five to sixty-seven feet, only the dark and compact lower till, or ground moraine, was found.

The trend of this chain of islands is about east-north-east, but on the peninsula of Cape Cod the same belt of hills, continuing with its width, contour and material unchanged, bends within a few miles to a course nearly due north. A railroad cutting thirty feet deep in these deposits, near Wood's Holl, and shallower sections on the Quisset hills, show two or three feet of yellowish till at top, succeeded below by light gray till, equally coarse but apparently more compact, with some of its fragments planed and striated. The latter was probably accumulated beneath the ice-margin, while the former was dropped by its meltings.

After holding its way northward ten or twelve miles, reaching to a point about a mile south of North Sandwich, the range turns at a right angle to a course a few degrees south of east. Some portions of it in this vicinity are strown with boulders; but mainly, as shown on the roads which cross these hills south-west and south from Sandwich village, at the highest portion of the entire series, they consist of stratified gravel and sand with boulders rare or entirely wanting. There is also a change to a more simple contour with fewer irregular hills and hollows.

From its angle the range extends about thirty-five miles to the east shore of the Cape. Through Sandwich and Barnstable it lies about a mile south of the railroad, consisting in the latter town of hills one hundred to two hundred feet high, apparently formed of modified drift, with frequent boulders embedded in it and scattered upon its surface. In Yarmouth the series is somewhat broken, and the railroad crosses it upon a sand plain a little west of German's hill. South of Dennis pond and for one and a half miles north-east from German's hill to Follin's pond, it is very well shown in exceedingly rocky low hills. Next it appears to suffer an offset of about two miles to the north, being represented by Scargo hill in Dennis, which is modified drift with only few boulders. Thence it runs a little north of east six miles to Brewster station, where it is again crossed by the railroad.

Through most of this distance it is very rocky, some of its blocks being twenty to thirty feet or more in diameter. Its further course is mostly modified drift with occasional boulders, passing east-north-east to Mill hill, Orleans village, and the south-east side of Town cove, beyond which it is concealed beneath the ocean.

The conclusion of Mr. Clarence King,[1] that Naushon island which he examined, forms part of a terminal moraine of the continental ice-sheet, seems to explain the accumulation of this remarkable series of hills. The border of the ice, after falling back from its farthest limit, stopped at this line or re-advanced to it, and afterwards remained nearly stationary through a long period, in which the materials that it contained were being continually brought forward and deposited. In many places these would be pushed into very irregular heaps and ridges by slight retreats and advances of the ice margin. At the same time we should also expect that thick beds of ground moraine would be gathered beneath the ice near its termination. The withdrawal of the ice-sheet would then leave these deposits as upper and lower till, one overlying the other in a long but broken and undulating range.

The angle of this range at North Sandwich shows that the portion of the ice-sheet on the west and that on the east pushed against each other here, the motion and slope of each being directed toward its line of frontal moraine. The medial moraine produced where their slope came together north from the angle of their terminal line, is presented in Rocky, Manomet and Pine hills, which form a gigantic ridge in the east part of Plymouth, four miles long from north to south, with a continuous height three hundred to four hundred feet above the sea. Abundant angular boulders of all sizes up to twenty feet in diameter strew its surface. At the north end of this ridge the sea has undermined its base, forming a steep slope sixty feet in height. A section here showed twenty feet of upper till, yellowish, with abundant large and small boulders, nearly all of them angular, underlain by lower till, dark bluish gray, with small glaciated stones, exposed for twenty feet vertically but concealed below. The bed of boulders which forms the shore at this point came mostly from the upper stratum, and their sharp corners and edges have since been worn away by the waves.

[1] Proceedings of Boston Society of Natural History, Vol. XIX, p. 62.

Besides the till, or boulder-drift, it has been stated that stratified gravel and sand, nearly or quite free from boulders, make up a large part of these series of morainic hills, including their highest portions on Long Island and Cape Cod. We thus see that the ice was aided in the accumulation of its terminal deposits by streams laden with vast quantities of modified drift. These streams appear to have been formed during the meltings of summer upon the surface of the ice-fields, especially at the period when they yielded and were driven back by a warmer climate.

To understand how such rivers could get their freight of gravel, sand and silt, we must consider what the ice-sheet was. The interior of Greenland is now covered by a similar field of ice, which rises steeply at its edge, but after a few miles changes to a gently inclined plateau, elevated above the highest peaks of the land on which it lies, and apparently of immeasurable extent. Dr. Hayes found the angle of ascent on this plain to decrease from six to two degrees in thirty miles, at which distance he reached an altitude of about five thousand feet. The ice of the glacial period had a similar, but probably less steep, ascent from its terminal front northward. The temperature of its area was changed so that the snows of autumn, winter and spring were not entirely removed in summer, but very slowly increased in depth, their lower portion being changed to solid ice. This continued through so long a period that the surface of this ice-sheet was lifted above the highest mountains of New England. At the White mountains, two hundred miles north from its border, it rose to a height at least 6300 feet above our present sea-level. Its greatest thickness was far to the north, from which region the vast pressure of its own weight caused it to flow slowly outward. Even its lower portion, which rested on the uneven surface of the land was thus pushed forward over all our hills and mountains, transporting boulders and marking its course on the ledges. Over British America, as far north as the surface geology has been explored, and to the most southern limit reached by the ice-sheet, which coincides nearly with the course of the Columbia, Missouri and Ohio rivers and the south coast of New England, the direction of its motion, as shown by the striæ, was generally southward, being nearly due south in British Columbia, south-west in the region of the great lakes, and south-east between Hudson river and the Gulf of St. Lawrence. The loose materials which covered the

land were ploughed up, and as the ice moved forward over the irregular surface, it became more or less filled with boulders, gravel and sand, at least to the height of the peaks and ridges which it crossed. Differences in the slope of the surface of ice above, like those which made an angle in the terminal moraine, due apparently to inequalities in the amount of snowfall and of melting upon adjacent regions, must also produce downward and upward currents by which these materials would be distributed throughout the lower part of the ice, probably to the height of several hundred feet, even while crossing a nearly level area.

By the melting of the ice-sheet at and near its terminal front, this detritus was exposed, through every summer, to the washing of many rills and small streams; but before its retreat under a change of climate, this melting was extended over a very wide area. The surface of the ice was then hollowed into basins of drainage and channelled by rivers, which became heavily freighted with the gravel, sand and clay that had been held in its mass. A large portion of this gravel and sand was heaped at the edge of the ice-sheet, where these glacial rivers descended to the lower open area beyond. When the ice behind them disappeared these deposits were left in the massive hills and ridges of stratified drift which form so prominent a part of these series of terminal moraines. [*To be Continued.*]

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THE GEOLOGICAL MUSEUM OF THE SCHOOL OF MINES, COLUMBIA COLLEGE.

BY ISRAEL C. RUSSELL.

AS it is impossible for every one to visit distant lands, or even at all seasons to go forth into the fields and among the mountains in quest of geological knowledge, we desire to call the attention of our readers to a collection in our country which in a great measure will supply these wants. We refer to the Geological Museum under the direction of Prof. J. S. Newberry, at the School of Mines, Columbia College, New York city. Here the visitor will find a most interesting display of the remains of the ancient inhabitants of the globe, gathered not only from the rocks of our own country, but also from the most distant lands, and each arranged in its proper place in the long series.

The geological museum occupies the entire third story of the

eastern wing of the School of Mines building, and consists of four collections, all of which, however, have an intimate connection with each other. The first and most interesting of these is the geological and palæontological collection, which will be the subject of our present sketch. This is supplemented (firstly) by a lithological collection consisting of three thousand specimens of rocks and the minerals which compose rocks; (secondly) by a collection in economic geology, containing nine thousand specimens of coal, ores, marbles, fertilizers, etc., illustrating the mineral wealth of our country, and containing also suites of ores and associated rocks from many of the most important mines in foreign lands; (thirdly) as an aid to the study of the fossil remains of animals and plants, which constitute the most attractive branch of geological knowledge, a zoölogical and botanical collection has been added, composed of well-selected specimens which in some peculiar manner serve to explain the fossil forms. This collection in some departments, as in that of fishes, contains many remarkable and interesting and valuable specimens.

The portion of the museum to which we wish to introduce the reader is the first we have mentioned, that of geology and palæontology. This collection occupies the wall and table cases on the eastern side of the hall; many large specimens, however, as the skeleton of the Irish elk, a cast of the Megatherium, etc., are arranged in various parts of the museum.

The cases, commencing at the northern end of the hall and extending throughout its entire length, present the geological records from the earliest dawn of life on our planet down to the last chapter in its history—the introduction of man.

These sibyl's pages, gathered from the ends of the earth, present an epitome of the world's ancient history written by the unprejudiced hand of nature. These fragments of stone with the curious forms of animals and plants engraved upon them, are to the geologist—the interpreter of the earth's history—what the hieroglyphics of Egypt or the picture-writings of Mexico are to the archæologist—the translator of human history.

Before we enter into an examination of the remains of animals and plants which once lived upon the earth, but are now extinct, we should clearly understand that fossils are the records which these ancient organisms have left of their existence. In some instances, as with the Irish elk and the moa of New Zealand,

we find the bones themselves but little altered from their original condition. At other times the organic matter of the specimen, a piece of wood, a bone, a shell it may be, have been replaced by silica so as not only to retain the general form, but even the most minute structure of the original substance. Such a replacement is called petrifaction. Wood is frequently thus petrified so as to preserve its microscopical structure as perfect as it was when the plant was yet in leaf. Again we may find but the impression of a fern or of a fish, made in soft mud or sand, which has been hardened into rock and has faithfully preserved the form of the frail body that perished ages ago. The plastic mud along the shores of bays and rivers is frequently trodden by animals or pitted by falling rain-drops; such a surface by becoming covered by a layer of sand or mud may retain for indefinite ages the inscriptions thus impressed upon it. In these and many other ways, the life-history of distant ages has been written on the rocks and preserved to our own day, with an accuracy and fidelity which cannot be too highly appreciated.

The great interest connected with the first appearance of life on the globe is indicated by the prolonged discussion that took place in reference to the organic nature of the eozoön, which, as far as at present known, is truly the "dawn animal" of the world. Specimens of this interesting fossil are contained in the first case at the northern end of the geological hall. Now that we have made the first step in our journey through the geological ages as here arranged, we will pass slowly down the long row of cases, and in doing so, review hastily the life-history of the earth.

The Eozoön belongs to the lowest sub-kingdom of animal life, the *Protozoa*, which also embraces our familiar sponges, the structureless amœba, etc. The case containing the Eozoön shows us also the forms of life that followed this humble beginning. These are the fossils of the Silurian age, or the age of mollusks, as it is sometimes called in reference to the great abundance of the remains of "shell-fish," which far outnumber all the other fossils of this formation. The collection contains six thousand specimens of this ancient fauna, which were all embraced in the first four sub-kingdoms of animal life. The *Protozoa* are represented by the Eozoon, sponges, receptaculites, etc.:—the Radiates by corals, crinoids, and star-fishes. The Mollusks, as we have mentioned, were in great force, as the fossil shells testify. The

numerous trilobites, with the Eurypterus, Pterygotus, etc., show us that the Crustaceans were the highest form of life on our continent during the Silurian age. But while the Crustaceans were the highest in point of structure, yet they were far inferior in size and strength to the Cephalopods, the highest of the Mollusks, which lived in the same seas. These were represented by huge Orthoceratites. As we stand beside the cases containing these beautifully preserved remains, it is not difficult to restore them once more in fancy to the ancient waters in which they lived, and to picture to ourselves the appearance of the earth in that distant age. All the remains of animal life which these cases contain are those of marine forms. All the remains of plants, too, discovered in the rocks of this age have been classed with the Algæ (or sea-weeds). Judging from the fossil records, which, however, we feel are incomplete, we conclude that no plants grew upon the Silurian land areas.[1] There was then but the broad ocean and the wild desolate shores, uninhabited by beast, or bird, or plant—even more dreary and silent than are now the barrenest islands of the southern oceans. Along these primeval shores the waves rolled in and ground away the rocks as they do on the coast to-day, and retreating left the sands with a ripple-marked surface or covered with the trails of worms and crustaceans. Many of the shell-fish and trilobites lived along the shore, perhaps sheltered by clumps of sea-weed and clinging brachiopods, others inhabited deeper waters and contributed their remains to the formation of the limestone in which we now find them.

With this imperfect glimpse of our country in the Silurian times, we must pass on to the fauna and flora of the next succeeding, Devonian, age. Again naming the era from the ruling forms of life, we call this the age of fishes. Although in Europe the first fishes made their appearance in the preceding age, yet in our country we find their earliest remains in the Devonian rocks, throughout which time they continued to be the highest forms of life on the globe. What at once strikes the observer upon glancing over the splendid display of Devonian fossils here brought together, is the almost total absence of the forms with which we have already become familiar in the Silurian. Here begins a new chapter in the ancient archives. The few inches

[1] Since this was written a number of species of land plants have been described from the Silurian rocks of our country by Mr. Leo Lesquereux.

that separate the Silurian from the Devonian fossils represent in reality an immense lapse of time, during which the fauna of the world underwent great changes. We will not say that all the old forms of life were exterminated and new beings created to take their places, nor can we prove that during these unknown ages the laws of development were slowly changing the plastic organisms into new forms better adapted to meet the altered conditions under which they were forced to live. We can only say that the record is broken: to-morrow the missing chapters may be discovered and new light thrown upon the enigma, but to-day we must pass it by. But while most of the fossils of the Devonian differ in genera and species from those of the older fauna, yet they belong to the same families and orders, with the exception, of course, of the fishes, which are new to the life of the world. The corals, mollusks, and crustaceans are present in great numbers, and in a general way resemble their representatives in the Silurian, but on the whole they present greater diversity and indicate more advanced conditions. The presence of corals in the rocks of this age in what are now the Arctic regions indicates that there was little diversity of climate at the time these animals were alive.

The fossils which particularly attract the attention in these cases, and which will always be a center of interest to the student of the Devonian, are the remains of fishes, of which this collection contains a grand display that is unrivaled by any other museum in this country. Many of these fossils are unique, and in some instances are the only specimens of their kind known; many of them being the types figured by Prof. Newberry in the Geological Reports of Ohio. Among the first objects to attract the attention are the great sword-shaped spines which are the type-specimens of the genus *Machæracanthus*; these highly-polished spines, some of which are twenty inches in length, are samples of the weapons worn by the old Devonian sharks. These ancient fish-spines illustrate the economy that is shown in so many of nature's works, in gaining great strength with the use of the smallest possible amount of material. Here also are the type-specimens of the genera *Acanthaspis* and *Acantholepis*, which show a strange combination of plate and spine that is unknown in modern fishes. Another slab of limestone shows the head of an old Devonian fish that measures seven or eight inches in length. The head of this fish was completely encased with solid bony plates that

were strongly united by sutures and highly ornamented on the exposed surfaces. This fish, which has received the long name of *Macropetalichthys*, seems to have had many features in common with the structure of the living sturgeon. One of the strangest fishes that ever swam in the Devonian seas, and which surpasses in interest even the *Pterichthys* and *Coccosteus* of the old world, is the *Onychodus*. Among the most unique specimens in the museum is a slab of limestone from the Corniferous rocks of Ohio, containing a nearly perfect mandible of this fish, which is fourteen inches in length and set with sharp conical teeth. At the junction of the two rami of the lower jaw, there occurs a crest of seven large curved teeth which seem to have projected beyond the massive jaws, thus forming a terrible weapon, whose use seems to have been analogous to that of the sword in the living sword-fish. Far more wonderful than any of these, and one of the strangest monsters ever exhumed from the cemeteries of the primeval world, is the *Dinichthys*, described by Prof. Newberry from the Huron shales of Ohio. The nearly perfect bony casing of this "terrible fish," which is exhibited, shows it to have been upwards of twenty feet in length; and judging from its formidable armament, it was by far the most destructive creature yet known from the Devonian rocks. The jaws are massive plates of dense bone, each two feet in length, and provided with sharp-cutting and serrated edges. The anterior ends of the mandibles are upturned and united so as to form one immense tusk-like tooth, which shuts in between two equally massive premaxillaries on the upper jaw. The jaws of *Dinichthys* may be well represented by the arms of a man extended to their full length with the hands turned up and pressed together to represent the great tooth at the junction of the mandibles. One of the most curious and interesting features connected with this discovery is the striking analogy that exists between the structure of the *Dinichthys* and the mud-fish (*Lepidosiren*) now living in the rivers of Africa and South America. The number of these Devonian fishes is so great that we can but glance at a few of the more interesting ones that remain. Beside the dorsal shield of *Coccosteus* from the Old Red Sandstone of Scotland, is placed the only similar specimen known of *Coccosteus* from this country. Here too is the type-specimen of the genus *Heliodus*, one of the most ancient of the Dipnoi. Specimens of *Rhynchodus* show us that the modern Chimæra belongs to a very ancient family.

We cannot linger over these ancient relics, which are but waiting the pen of a Hugh Miller to make them familiar to every reader in our land, but must pass on to other features of the Devonian, which are well exhibited in these cases. Our readers will remember that the shores of the Silurian ocean were barren solitudes. Not so was it in the Devonian. We have here before us the remains of a strange and luxuriant flora that shaded the land. Ferns grew luxuriantly; above these flourished the strange *Lepidodendrons*, with which we shall become more familiar in the age that follows. We have here the first appearance of the most beautiful of land-plants, the tree-ferns, which at the present day form such an attractive feature in the scenery of the tropics and of the islands of the South Pacific.

The next series of cases contains the remains of the fauna and flora that flourished in the Carboniferous times—the age which witnessed the formation of the great coal-fields of America. Here the scene again changes. The mollusks and crustaceans, the huge ganoids and the strange flora, of the Devonian age, have disappeared never to return again. Another cycle in the world's history has been completed. The fossils which we have now to examine are, as before, the remains of shells, fishes, plants, etc., but all very different from those of the Devonian. Fishes appear again in great numbers, but not the huge Placoganoids that we saw before, but the elegantly-formed Lepidoganoids, covered with little plates of enameled bone. The most beautiful of these fossil fishes are from the cannel coal deposits of Linton, Ohio. The fossilization in these specimens is peculiar. Each little plate of mail and each delicately-penciled fin seem wrought in gold-leaf on a black ground. In reality, the substance which represents the fish is iron-pyrites, on a surface of impure coal. These little fishes have received the generic title of *Eurylepis*, in reference to the breadth of their scales, and such specific names as *corrugata*, *insculpta*, *lineata*, *ornatissima*, etc., suggested by their delicate ornamentation. Specimens of *Cœlacanthus*, which occur with the *Eurylepis*, are even more highly ornamented, and have their scales and head-plates so elegantly chased that the most skillful gem-engraver could scarcely imitate their delicate tracery. The great fin-spines which these cases contain, show that the sharks were strongly represented in the Carboniferous waters. Here too are the teeth of the most gigantic ray ever discovered (*Archæobatis*),

some of the flat crushing teeth of which were six inches in length, four inches wide, and an inch and a half thick.

Some of the slabs of stone from Linton, Ohio, upon being split open, showed the heads, limbs, scales, etc., of *Amphibians*, represented at the present time by the frogs and salamanders. It is at once apparent that this is the heading of a new chapter. In all the stony pages that we have glanced over, we have not seen characters like these. If we should follow out the records here begun, through all the following ages, we would find, indeed, that it is a chapter of wonders, containing the lives and struggles of the hugest and strangest monsters that have ever lived. We cannot pass on, however, without glancing at the flora of the Carboniferous, the relics of which these cases contain to overflowing. These forms, that are traced so delicately on the stones, were once living plants that millions of years ago bowed to the passing winds and drank in the sunshine as our most familiar trees and ferns do to-day. These fragments of trunks, branches, leaves and cones give us a faint glimpse into the dark moist forests that clothed our land in the coal period. Many of the fossil plants we at once recognize as ferns, so nearly do they approach in form these beautiful plants which we meet in all our rambles. Others, after considerable study, have been shown to be closely related to the little ground-pines or club mosses, which are also quite common in our woods. These ancient Lycopods, however, instead of being only a few inches in height, with cones an inch long, were gigantic trees sometimes upwards of seventy or eighty feet in length, with elegantly scarred trunks, and bearing large cones upon their gracefully pendant boughs. Another of our common plants, the Equisetum, also had giant representatives in that ancient flora. These, together with the Sigillarias, with their beautifully fluted columnar trunks, furnished the material from which our great stores of coal were formed. What at once appears as a remarkable fact upon looking over these fossils, is that they all belong to the lowest grade of vegetation, the cryptogamous or flowerless plants. Among all the hundreds of coal plants here assembled, we look in vain for so much as a single leaf of a broad-leaved plant like our maples and oaks. It was long supposed that there was a total lack of flowers in the Carboniferous forests, but a specimen in this collection shows a branch of some unknown plant with the remains of flowers clearly distinguishable.

As we pass on to the records of the next succeeding (Mesozoic) eras, the mediæval age of geology, we find no mention made of the luxuriant forests and the abundant animal life that passed before. Nearly all remembrance of these seems lost in antiquity. This age, in reference to the predominating forms of life, is called the reptilian age. The first indications that we have of these new rulers of the land and sea, are their foot-prints, left along the muddy shores. Some of these from New Jersey and the Connecticut valley are shown in the case of Triassic fossils. These wonderful impressions are so well known through the writings of Prof. Hitchcock and others, that we need do no more than mention them. The rocks in which these foot-prints were found have also furnished great numbers of fossil fishes. Among hundreds of specimens of these Triassic fishes here assembled, there is one called *Ptycholepis*, with highly ornamented head-plates and plicated scales, which is the only American specimen known of this genus, which occurs in the Lias of Europe; here too is the only specimen yet discovered of *Diplurus*; this was lately obtained from the Triassic rocks at Boonton, N. J. The rocks of this age have also yielded the oldest remains known of the Mammalia. This sub-kingdom makes its appearance in one of its humblest orders, the Marsupials, represented at the present day by the opossum and the kangaroo.

In the flora of the earlier portion of this age we find ferns, calamites, and conifers, with the addition of a new feature, the Cycads. As we pass on to the cases containing the fossil plants from the latest period of this age, the Cretaceous, we come suddenly to a splendid display of fossil leaves which have a wonderfully familiar appearance; they are the leaves of oaks, willows, maples, beeches, sycamores, etc., which the most casual observer would refer to the same genera that are living at the present day. There are differences which show that all these fossil leaves are specifically distinct from their modern representatives.

Among the most striking forms of animal life in the Mesozoic, were the Cephalopod shells, related to the living Nautilus. Of these, the ammonites which were foreshadowed by goniatites in the Devonian and Carboniferous, and began to assume their characteristic elegance of outline in the Triassic, in the Cretaceous attain a degree of variety and beauty that could with difficulty be excelled. It is interesting to observe that after these mollusks

had slowly attained this surpassing degree of elegance and ornamentation, the whole family became extinct. The collection contains many of these chambered shells from the Cretaceous of the Upper Missouri, which still retain their nacreous walls, that after the lapse of ages are as beautifully iridescent as any living shell. Here also are the bones of some of the great reptiles of the Cretaceous, the teeth of fishes, and a great variety of shells and plants from the same rocks. Many of these specimens are of great scientific value, as they are the type-specimens upon which many of the genera and species of Cretaceous fossils were founded.

The last case at the southern end of the geological hall contains the fossils of the Tertiary period, the last period but one before the age of man. A glance at the contents of this case shows us that all the grand divisions of animals and plants which are living at the present day, are represented. The shells of this period exhibit a very modern aspect, especially when compared with the older ones we have been studying; although many of them belong to living genera, yet nearly all the species are extinct. The tertiary plants, which are shown in great abundance, prove that the flora was not very different in its general character from that clothing the Middle States at the present day. The higher vertebrates at this time appeared in such numbers and variety that this age is known as the age of mammals.

While lingering over the cases of Silurian fossils, we attempted briefly to retrace the picture of that age, with its small and barren land areas and its great oceans tenanted by the lowest forms of animals and plants. Let us contrast with the silent barren aspect of our continent in those primeval days, its appearance in Tertiary times. North America had then attained nearly its present outline, although extensive regions along the Atlantic and Gulf borders were yet beneath the ocean, and great lakes occupied the western interior. A flora of temperate or sub-tropical growth clothed the area of the United States, and the climate of Virginia reached as far northward as Greenland. The splendid collection of Tertiary plants from the region of the Upper Missouri, the Yellowstone, and other portions of the West, shows that the banks of the Tertiary lakes, which then existed at these localities but have since been filled, were fringed with a varied and beautiful vegetation. We find among these fossil plants the leaves of the maple,

oak, hickory, conifers, etc., together with others that now grow far to the southward, as the palm, magnolia, cinnamon, and fig. Many of these fossil leaves are of double value, as they are the type-specimens from which Prof. Newberry has described and figured this wonderful flora, rich both in species and individuals. When we inquire what animals lived in these luxuriant forests, a vast menagerie of strange forms passes before us. We can do no more than call a hasty muster-roll of names. Our country was then inhabited by great numbers of animals more or less related to our modern horse, tapir, wolf, panther, stag, musk, rhinoceros, camel, llama, etc. Besides these there were a large number whose modern representatives are not so well known,—as the *Oreodon*, *Menodus*, *Uintatherium*, *Hyænodon*, and many others. This is but a meager list of the great number of Tertiary animals that have been discovered, but sufficient to show that a far richer and more wonderful assemblage of animals inhabited our land at that time than can now be found living on any continent; not even the jungles of India can produce such an array of gigantic pachyderms and carnivores as then lived in this country.

Again we are obliged to add, as with all the preceding ages, that both the luxuriant forests and these thousands of strange animals have become extinct, never again to appear on the earth. Dana remarks that "all the fishes, birds, reptiles and mammals of the Tertiary are extinct species."

As we are writing sober facts and not attempting to trace an Arabian tale, we should hesitate to speak of the times that follow the Tertiary, so strange and wonderful are they, did we not have in the collection before us the unquestionable facts engraved upon tables of stone. As the climate of the Middle States in former ages extended to Greenland, so, on the other hand, there came a time, after all the fair picture of Tertiary days was blotted out, when the present climate of Greenland, with vast snow-fields and continental glaciers, reached as far southward as New York and Cincinnati;—a time when glaciers many thousands of feet in thickness moved southward over our Northern States, grinding down the country and exterminating nearly every form of life that before had found there a congenial home. This collection contains a large number of specimens of the boulders, the boulder-clay, and the polished and scratched surfaces, that the glaciers left behind them.

After the snow and ice of this great geological winter had passed away, and a climate very similar to that which we now enjoy had covered the land with its present flora and fauna, we find the first clearly acceptable evidence of the presence of man. The geological records before us are brought down to our own time by many relics of the stone-age of Europe and America, besides a collection illustrating the arts of the Egyptians and Etruscans. Here, too, is a cast of the celebrated fossil-man of Guadaloupe, the original of which is in the British Museum.

One of the most interesting truths illustrated by the geological collections at the School of Mines, is the fact of the humble beginning of both plant and animal life on our globe, and their constant increase both in variety and specialization, as we follow their progress through the geological ages. Every one who is interested in the great question of our time—evolution—should make himself familiar with a collection of fossils arranged geologically, in order that he may see with his own eyes the facts written in the great stone book of the geologist, on which the man of science bases his theories and conclusions.

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RECENT LITERATURE.

BREHM'S ANIMAL LIFE, BIRDS.[1]—Lovers of birds, even if they are not those of the United States, will be interested in this excellent work of Dr. Brehm, of which the first two volumes lie before us. The first volume begins with an account of the skeleton, and anatomy of the soft parts, while their physiology is briefly discussed, also the motions of birds, their songs and powers of speech, sense-faculties, psychology, distribution, development, their every-day life, their courtships, pairing, nesting and breeding habits, early life and migrations. Dr. Brehm's classification is as follows: The parrots head the series and form the first order; they are succeeded by the trogons, etc. (*Levirostres*), the humming birds (*Strisores*), the fourth order of *Pici*; then come the birds of prey. The second volume completes the account of the *Accipitres*; these are succeeded by the Passerine birds, the second volume ending with the *Gyratores*, or pigeons, and the dodo. It will be seen from this enumeration that the classification adopted by the author, a distinguished German ornithologist, is somewhat unlike that of Lilljeborg, a Swedish naturalist, adopted by most American authors, as the Passeres are, at the present day, placed

[1] *Brehm's Thierleben.* Allegemeine Kunde des Thierreichs. Grosse Ausgabe. Zweite Abtheilung. Die Vogel. Von Dr. A. E. BREHM. Band 1, 2. Leipzig, 1878. 8vo. New York, B. Westermann & Co. 40 cents a part.

at the head of the class. It is also unfortunate that the "orders" of birds are perpetuated, even in a popular work, since it is doubtful whether they should rank higher than sub-orders.

The singing birds (*Passeres*) are treated with great fullness of detail, and as these form the larger proportion of our native birds, amateurs and naturalists will find this a most popular and useful part of the work. The index of each volume is voluminous, while the illustrations are abundant and beautiful, the two volumes containing 346 woodcuts, many of them of life size, and thirty-seven full-page engravings, mostly drawn by Mützel, Kretschmer and others. They are fully up to the standard of those in the earlier volumes of the series, to which we have called attention.

The birds will be completed in a third volume. Two additional volumes will be devoted to fishes, finishing the series of ten volumes announced by the publisher, and which will, without doubt, be issued during the coming year.

SMITH'S STALK-EYED CRUSTACEA OF THE ATLANTIC COAST.[1] —This paper is based on the collections of the U. S. Fish Commission, and is of great value. In it are enumerated seventy-nine species of decapod Crustacea, which are or have been found in the limits named. Many so-called species are here for the first time united, a feature which agrees perfectly with the reviewer's convictions. These seventy-nine species have been described under 126 specific names. In relation to the geographical distribution of *Carcinus mœnas* we would say that we have found it in the collection of Union College, from Northhampton county, Eastern shore, Atlantic side, Virginia. This is the farthest south that the species has been observed on this coast. A new species of *Geryon* (*G. quinquedens*) is described and figured, as is the only other known species (*G. tridens*). It differs from Kroyer's species in having the antero lateral margin five toothed. *Cancer borealis* is figured for the first time. *Chionœcetes behringianus* Stm., is shown to be synonymous with *C. opilio* (O. Fabr. sp.). The name *Libinia canaliculata* Say, has to give precedence to *L. emarginata* Leach. *Parapagurus pilosimanus* (nov. gen. et sp.) is described. This genus is allied to *Eupagurus* and *Paguristis*, but has the gills composed of cylindrical papillæ instead of lamellæ as in most Paguroids. We have observed a similar structure in the genus *Carcinus*. A second species of the genus *Sabinea* (*S. sarsii*) is described and figured. *Hippolyte securifrons* Norman, is new to our coast. *Pandalus annulicornis* has to give way to the name *P. montagui*. In regard to *Palæmonetes vulgaris* we would say that besides the specimens from Salem Mill-pond (C. Cooke) we have seen specimens in the museum of the Peabody Academy at

[1] *The Stalk-eyed Crustaceans of the Atlantic Coast of North America, north of Cape Cod.* By S. I. SMITH. (Trans. of the Connecticut Academy of Arts and Sciences, Vol. v, pp. 27–136, pls. VIII–XII, May, 1879.)

Salem, from Lynn, Mass. (collector's name not given) and Massachusetts bay (Capt. W. H. A. Putnam). *Meterythrops*, a new genus of Schizopoda is characterized and figured. It has the cephalothoracic appendages of *Parerythrops* with the abdominal feet in the female rudimentary, and in the male as in *Erythrops*. Sar's *Chiromysis microps* is shown to be congeneric with *Heteromysis formosa* Smith. Following this list, which we have thus briefly noticed, is a valuable account of the geographical distribution of these species. We would, however, note that contrary to the statement on pp. 127 and 128, the genus *Platyonychus* is represented in Europe by two species, *P. nasutus* of the Mediterranean, and *P. latipes*, with a larger distribution. It is shown that contrary to the opinion of European zoölogists, the fauna of Greenland is as closely allied to that of North America as to that of Europe, "or in other words, it is only part of the great arctic, circumpolar fauna."—*J. S. Kingsley.*

Ingersoll's Nests and Eggs of American Birds.[1]—Our notice of this important accession to the literature of American ornithology has been too long delayed. It is a work for which there is room, and one which bids fair to take and fill acceptably a place of its own. No work has yet been provided for the special needs of American oölogists, the one attempted many years ago by Dr. Brewer having failed of accomplishment after the issue of the first fascicle. There are very many persons in this country, especially among the rising generation, who will be glad to have an egg-book "all to themselves"—one that will teach them the distinctive breeding habits of birds, enable them thus to find nests and eggs, and when found to make a collection of them. Such a work Mr. Ingersoll proposes to furnish, and the first installment of his undertaking gives promise that he will discharge his self-imposed obligation faithfully.

To judge from the portion already issued, this treatise will win its distinctive position and secure a name among numerous competitors in the field ornithological, by conforming to the implication of its title. Mr. Ingersoll does wisely, we take it, in restricting himself rigorously to his theme, even at the expense of a certain appearance of incompleteness which may strike some unfavorably; for it would be of no special use to undertake the systematic treatment of North America ornithology. Evidently believing that good style may be serviceable even in statement of fact, the author would combine literary excellence with scientific merit. Recognizing, furthermore, how much has already been done in his chosen field, he seems to prefer to quote a satisfactory description of nest or egg rather than to produce a duplicate, the concern being rather for the quality than the source of the informa-

[1] *Nests and Eggs of American Birds.* By Ernest Ingersoll. S. E. Cassino, Naturalists' Agency, Salem, Mass. Part I, pp. 24, pls. II. (*Pub. March*, 1879.)

tion he has to offer. These are all such desirable points that their faithful observance throughout the work cannot fail of good result.

The present Part treats of about a dozen species of *Turdidæ*. We doubt that it is a fair sample of what the whole work will be, as we presume the author will improve as he settles more closely to his task; yet the standard here attained is high, fully warranting what we have already said. The appearance of the work is attractive, and the mechanical execution good, with one exception: the references to the plates are insufficiently explicit, or rather not prominent enough. It is impossible to number or letter plates too plainly, or make the textual references too conspicuous. We venture to suggest to the author, that, at the risk of typographical difformity in succeeding parts, the full reference to the plate and figure be made a conspicuous part of each species-heading; and to the publisher we further recommend that the lettering of the plates be bolder. As Allen recently said, in substance, in the *Nuttall Bulletin*, the names of the species the eggs of which are figured, might be advantageously substituted for the legend now usurping a place at the bottom of the plates; and this running title be transferred to the right hand top corner.

There is one grave defect of the work that we cannot suffer to pass unrebuked. There is nothing to show whether Part 1 was published in March, 1879, as happens to be the case, or in some other month of some other year. In giving no date, both author and publisher, they and their book, run their chances of being mentally consigned by some irate bibliographer of the future to a less desirable place than a niche in the temple of posthumous fame. We are personally cognizant of various persons who have already, in fact, met with a fate so deplorable, on this very account.

It remains to speak of the execution of the plates, briefly, for the less said the better, unless it should stimulate the artist and publisher to renewed exertion to bring the drawing, shading and coloring of the figures nearer the standard of excellence required for the fit illustration of so admirable a treatise as the "Nests and Eggs of American Birds" aspires and promises to be.—*E. C.*

Texan Ornithology.—After lying fallow for some years, the field of ornithology along our south-western frontier has been worked over with energy and success by several competent observers, whose labor has resulted in adding some *thirty* species to the recognized fauna of the United States, besides greatly enlarging the bounds of our knowledge of the life-histories of these and numerous other birds with which we were none too familiar. The name of Mr. H. W. Henshaw will instantly recur to one in this connection; if we remember right not having the exact figures at pen-point, about half of these acquisitions

have been made through his exertions, and fully elaborated in the reports of the surveys to which he has been so long and so usefully attached, either by himself alone or in connection with Dr. H. C. Yarrow. His operations having been mainly in New Mexico, Arizona and California, it has remained for others to do the like good service in Texas, and especially in the fruitful valley of the Lower Rio Grande, where so many Mexican birds intrude upon our own territory. The three prominent workers in this field of late, are Mr. George B. Sennett, late of Erie, Pa., Dr. James C Merrill, U. S. Army, and Lieut. C. A. H. McCauley, 3d U. S. Artillery.

When, in 1841, the late J. P. Giraud published his sixteen new species of birds from "Texas," the decidedly sub-tropical cast of the fauna of some parts of Texas was not fully recognized, and much doubt was felt that all these birds really came from their accredited locality. They have, however, been mostly rediscovered over our present border, and the true character of the bird-fauna of the Lower Rio Grande has been very thoroughly exposed by the investigations of Sennett and Merrill. McCauley worked farther north and west, in a region which, though not well known ornithologically, was not to be expected to yield Mexican novelties. His paper,[1] however, gave precision if not great enlargement to our knowledge, and very acceptably supplements Dr. S. W. Woodhouse's observations, published in 1853, with fresh and more extended notes on the habits and distribution of various species.

Mr. Sennett spent two months in the early spring of 1877 on the southern border of Texas, from the mouth of the great river to about a hundred miles inland; working with an assiduity that merited the large measure of success achieved, Mr. Sennett made an extensive collection, backed by copious field notes, and published[2] his results the following year. Containing a great store of fresh observations well worked up, this paper attracted much attention and received so many favorable notices that further endorsement of its claims to regard are scarcely required here. It may be stated, however, that Mr. Sennett's collection of 1877 contained several species new to our fauna, one of them new to science (*Parula nigrilora*), and another furnishing the occasion for the establishment of a new genus (*Æchmoptila albifrons*).[3] Seeing what abundant harvest was still to be reaped in that quarter, Mr. Sennett revisited Texas the following year, and made

[1] Notes on the Ornithology of the Region about the Source of the Red River of Texas, etc. Bull. U. S. Geol. and Geog. Surv. Terr., Vol. III, No. 3, May 15, 1877, pp. 655–695.

[2] Notes on the Ornithology of the Lower Rio Grande of Texas, etc. Bull. U. S. Geol. and Geog. Surv. Terr., Vol. IV, No. 1, Feb. 5, 1878, pp. 1–56.

[3] *Leptoptila albifrons*, a Pigeon new to the United States Fauna. Bull. Nutt. Ornith. Club, Vol. II, No. 2, July, 1877, pp. 82, 83.

still more important discoveries. Some of his results of 1878 have already been published,[1] including the announcement of five species new to our fauna, and the full account of that season's operations is now in press. Having had the pleasure of seeing his MS., we are confident that the forthcoming paper will rival its predecessor in importance and interest of contents; nor is it too much to add that Mr. Sennett shares equally with Mr. Henshaw and Dr. Merrill in the credit to be given for the development of the ornithology of our south-western border.

Meanwhile, however, a member of the medical staff of the army, as we are happy to say, had been showing that zeal in the cause of science which does honor to our corps, by his protracted and diligent researches in the same field. We have before had advices from Dr. Merrill on different occasions,[2] and have lately been favored with the full results of his observations, under Mr. Ridgway's able editorship, in a paper[3] which it is more particularly our present purpose to notice. According to an editorial note, Dr. Merrill's additions to the United States fauna are twelve in number, including two also taken by Mr. Sennett and first published by us as such, namely, the Mexican *Myiarchus* and *Buteo albocaudatus*, as well as the *Podiceps dominicus*, which raised such a grave question in the mind of Dr. Brewer. Four of them, the two *Amaziliæ*, *Parra gymnostoma* and *Nyctidromus albicollis* represent three genera not before recognized as North American.

[1] Later Notes on Texan Birds.—I [-V]. *Science News*, Vol. I, No. 4, Dec. 15, 1878, pp. 57–59; No. 7, Feb. 1, 1879, pp. 106, 107; No. 8, Feb. 15, 1879, pp. 120, 121; No. 9, March 1, 1879, pp. 132–134. No. 10, March 15, 1879, pp. 151–153.

New Birds for the United States Fauna. *The Country*, July 13, 1878, p. 184, top of first column. (Buteo albicaudatus, Scops enano, Crotophaga sulcirostris, Pitangus derbyanus, Ornithion incanescens [by error for *O. imberbe*].)

[2] Notes on Texan Birds. Bull. Nutt. Ornith. Club, Vol. I, No. 4, Nov., 1876, pp. 88, 89. (*Molothrus æneus*, *Nyctidromus albicollis*, *Pyrrhophæna riefferi*, *Parra gymnostoma*, *Podiceps dominicus*.)

A Humming Bird New to the Fauna of the United States. Bull. Nutt. Ornith. Club, Vol. II, No. 1, Jan., 1877, p. 26. (*Amazilia cerviniventris*.)

Note on *Podiceps diminicus*. By Elliott Coues. Ibid.

Dr. T. M. Brewer takes exceptions to the substance of our note in this case, much as usual of late. The point he raises might perhaps be settled if either of us knew whether the channel of the Rio Grande runs nearer the right or the left bank at Fort Brown; or even if he could satisfy himself that the same grebe might swim across the channel.

Notes on *Molothrus æneus*. Tom. cit. No. 4, Oct., 1877, pp. 85–87.

Occurrence of the Western Nonpareil and Berlandier's Wren at Fort Brown, Texas. Ibid, pp. 109, 110.

Occurrence of *Myiarchus crinitus* var. *erythrocercus* Sclat., at Fort Brown, Texas. Op. cit., Vol. III, No. 2, April, 1878, pp. 99, 100.

A new North American Buteo (*albocaudatus*). *The Country*, July 13, 1878, p. 184, near bottom of column.

Two more Birds new to the Fauna of North America. Bull. Nutt. Ornith. Club, III, No. 3, July, 1878, p. 152. (*Vireo flavoviridis*, *Sturnella mexicana*.)

[3] Notes on the Ornithology of Southern Texas, being a list of birds observed in the vicinity of Fort Brown, Texas, from February, 1876, to June, 1878. Proc. U. S. Nat. Mus., Vol. I, Oct., 1878, pp. 118–173, 3 pls.

Besides including these interesting novelties, Dr. Merrill's paper, like Mr. Sennett's, gives copious field notes of habits gathered in the course of the author's long experience with the subjects of his communication. The list of species reaches the large number of 252; and yet we understand that none are included which did not come under Dr. Merrill's personal observation. This is certainly a good showing, though doubtless no one knows better than the author himself that still further additions remain to be made to it. The large collections upon which the list is based were sent to the Smithsonian from time to time, and there carefully examined by Mr. Ridgway, upon whose authority the identifications rest. The same ornithologist has added much to the value of the paper by his critical commentary, and his insertion of extensive synonymatic lists and descriptions of the species new to our fauna or otherwise specially noteworthy. The evident care with which he has made his determinations causes us to regret the more our difference of opinion respecting the identification of the Mexican *Myiarchus*, which we had before satisfied ourselves to be *erythrocercus* of Sclater and Salvin, and a geographical race of *crinitus*. It seems to us useless to attempt to do anything with so doubtful a bird as *cooperi* of Kaup; and we must adhere to our previous decision. The hummers before announced as *Amazilia cerviniventris* and *Pyrrhophæna riefferi* are renamed respectively *A. yucatanensis* and *A. fuscicaudata*. The paper is further enriched by various oölogical notes contributed by Dr. Brewer, who appears to have examined the very large number of eggs collected by Dr. Merrill, and who has also given that slight sketch of the geographical distribution of *Podiceps dominicus*, to which we have already alluded. It is accompanied also by three of Mr Ridgway's plates, so excellent in details of external form, representing *Parra gymnostoma*, *Æchmoptila albifrons*, *Nyctidromus albicollis* and several species of *Caprimulgus*. Under such circumstances, both of authorship and editorship, it is not surprising that the paper forms one of the most notable contributions ever made to Texan ornithology, being, as such, quite worthy to rank with those of Sennett and Henshaw.[1]—*E. C.*

Recent Books and Pamphlets.—On the apical and oral Systems of the Echinodermata. By P. Herbert Carpenter. Part II. (Reprinted from the Quarterly Journal of Microscopical Science, XIX, new series.) 8vo, pp. 31.

The Geology of the Diamantiferous Region of the Province of Paraná, Brazil. By Orville A. Derby. (English version.) (Read before the American Philosophical Society, May 16, 1879.) 8vo, pp. 8.

[1] See also Mr. Brewster's review of the same paper, in the Nuttall Bulletin for January, 1879, pp. 50–52. A private note from Dr. Merrill informs us of a few typographical oversights which may be here noted. Page 128 *Embernagra rufivirgata*; p. 138 *Myiarchus erythrocercus*; p. 134 *Sturnella mexicana* should all be asterisked, and p. 133 *Sturnella magna* should not be thus marked. Page 131 insert initials "R. R." after "habitat;" p. 156 ditto after "measurements." Page 164 under *Herodias egretta*, the reference to "the preceding species" means *Plegadis guarauna* not *Ardea herodias*.

A List of the Fishes of Essex County, including those of Massachusets Bay, according to the latest results of the work of the U. S. Fish Commission. By G. Brown Goode and Tarleton N. Bean. (From the Bulletin of the Essex Institute, Vol. XI.) 8vo, pp. 38.

Notice of Recent Scientific Publications in Brazil. O. A. Derby on the Geology of the Lower Amazonas. By Richard Rathbun. (From the American Journal of Science and Arts, Vol. XVII, June, 1879.) 8vo, pp. 5.

Geological History of Jersey County. By Hon. William McAdams. Otterville, Ill. 4to, pp. 24.

Ist das Eozoon ein Versteinerter Werzeffüsster oder ein Mineral gemenge? Von Dr. Karl Möbius. (Separatabdruck aus der Zeitschrift. "Die Natur," Jahrgang, 1879, Ur. 7, 8, 10, Nalle.) 8vo, pp. 29, 21 illustrations.

Notes on Pacific coast Crustacea. By W. N. Lockington. (From the Bulletin of the Essex Institute, Vol. X, Nos. 10, 11, 12, 1878.) 8vo, pp. 7.

Description of a new species of Chirocephalus. By John A. Ryder. (From Proceedings of the Academy of Natural Sciences of Philadelphia.) 8vo, pp. 2.

Boletin del Ministerio de Fomento de la República Mexicana. (Daily Weather Report.) Folio. April 17th to May 8th, 1879. Mexico. From the Director of the Observatory.

Index Medicus: A monthly classified record of the current medical literature of the world. Compiled under the supervision of Dr. J. S. Billings, surgeon U.S.A., and Dr. Robert Fletcher, M.R.C.S., Eng. Vol. I, No. 4, April, 1879. 8vo, pp. 169–220. New York, F. Leypoldt. From the editors.

Catalogue of the Flowering Plants, Ferns and Fungi growing in the vicinity of Cincinnati. By Jos. F. James. 8vo, pp. 27. (Abst. from the Jour. Cin. Soc. Nat. History, April, 1879.) From the author.

A Revised List of Birds of Central New York. Based on the observations of Frank R. Rathbun, H. Gilbert Fowler, Frank A. Wright, Samuel F. Rathbun. Collated and prepared by Frank R. Rathbun. 8vo, pp. 47. Auburn, N. Y. (April 17th), 1879. From the Compiler.

Beskrivelse af Hovedskallen af et Kæmpedovendyr, Grypotherium Darwinii, fra La Plata-Landenes plejstocene Dannelser. Af. J. Reinhardt. Avec un résumé en Francaise. (Abst. Videnskab. Selsk. Skr., 5 Raekke. Naturvidenskabelig og mathematisk Afd. XII, 4.) 4to, pp. 353–380, Taf. I and II. Kjöbenhavn, 1879. From the author.

Characeæ Americanæ. Illustrated and described by Timothy F. Allen, A.M., M.D., etc. Part II.—Chara crinita Wallr. var. Americana. 4to, text and one plate. Published by the author, No. 10 E. 36th street, New York. From the author.

Aberrant dentition of Felis tigris. By R. Lydekker, B.A. (From Jour. Asiat. Soc. Bengal, Vol. XLVII, pt. II, 1878. Read Feb. 6, 1878.) 8vo, pp. 3, pl. I. From the author.

Further notices of Siwalik Mammalia. By R. Lydekker, B.A. Geol. Survey of India. (From Records Indian Geol. Surv., No. 1, 1879.) 8vo, pp. 33–52, with a plate. From the author.

Geology of Kashmúr (3d notice). By R. Lydekker, B. A. (Records Geol. Surv. of India, No. 1, 1879.) 8vo, pp. 15–32, and map. From the author.

Palæontologia Indica. (Memoirs of the Geological Survey of India.) Ser. IV. Indian Pretertiary Vertebrata. Vol. I, part 3.—Fossil Reptilia and Batrachia. By R. Lydekker, B.A., of the Survey. 4to, pp. 36, and six plates. Calcutta, 1879. From the author.

Anales del Museo Nacional de Mexico. Tomo I, Entrega 6a. 4to, pp. 237–278, 3 plates. Mexico, 1879. From the director of the Museum.

The Quarterly Journal of the Geological Society, Vol. XXXV, No. 138, May 1, 1879. 8vo, pp. 350, pls. 4. London, Longmans, Green, Reader and Dyer. From the Society.

Bulletin of the American Metrological Society. Officers, Committees, Constitution, By Laws. New York, 1879. From the society.

GENERAL NOTES.

BOTANY.

THE ROOT OF OXALIS VIOLACEA.—The violet wood-sorrel is an abundant plant in this locality, growing commonly on gravelly hillsides. On comparing it with descriptions it seems to agree in all essential points noted by authors; but there is one striking peculiarity of the root which appears to have been overlooked—at least I have not been able to find the slightest reference to it in any work that I have examined. This is the usual occurrence of a white, carrot-shaped root beneath the ordinary scaly bulb. When there is a bunch of plants a cluster of the tap-roots may be formed. They are only lightly attached to the under surface of the bulbs, so that when broken off the scar left is almost imperceptible. They consist for the most part of a watery fluid, which can be easily squeezed out, leaving but little solid substance. A thin, clear skin, together with the large quantity of water present, renders them somewhat translucent. The size varies, but from two to three inches appears to be the usual length. I have found them an inch or two long the first week in May, which shows that they are early developed. A not unpleasant sweet taste recommends them to children as suitable for eating; no injurious effects are noticeable.

During the past two years I have dug up many plants of this species in order to determine the presence or absence of such bottom roots. In most cases they were present, but in many they were not, though for what reason was not evident. Often of two plants side by side, one would possess the root fully developed and the other show no sign of it. Is this a feature of *Oxalis violacea* throughout its range? The observations of collectors in other parts of the country can decide the question.—*T. S. Roberts, Minneapolis, Minn.*

BOTANICAL NEWS.—The first volumes of the sixth edition of Dr. Asa Gray's Botanical Text Book, to be issued in four volumes, has just appeared under the title of "Structural Botany; or Organography on the Basis of Morphology," to which is added the principles of taxonomy and phytography, and a glossary of botanical terms. Three other volumes are contemplated as parts of this great work, one on physiological botany, by Prof. Goodale; one on cryptogamous botany, by Prof. Farlow, and one on the normal orders of phænogamous plants, by Prof. Gray.——The collection of plants made by Prejevalsky in his second journey to Central Asia, together with that of Potanin, is being worked up by the eminent botanist, Maximovitch and Regel, and the results will be published in a fine work on the flora of Mongolia and Kan-su. ——Mr. Lesquereux, the authority on the fossil plants of North America has just issued an "Atlas to the Coal Flora of Pennsyl-

vania, and of the Carboniferous Formation throughout the United States. It will be invaluable to all those who wish to identify coal plants, as 260 species are figured.——The *Botanical Gazette* contains a note on the influence of the scion on the stock, by T. Meehan, with a number of other notices.——Trimen's *Journal of Botany* prints a note on the morphology of the Characeæ, by S. H. Vines.

ZOÖLOGY.[1]

HABITS OF THE RED-HEADED WOODPECKER.—During the past three or four years much has been written in regard to the changes which are taking place in the habits of the red-headed woodpecker—"a versatile bird," to quote the apt characterization of Dr. Elliott Coues. This bird is quite common here, though I am of the opinion that it is not seen in as large numbers as it was when the country was first settled, some twenty-two years ago. I have often seen them about my barn-yard industriously picking up corn which had been shelled for the swine. Generally the bird alights and secures a single grain, and then flies off to the nearest tree-top to peck it into pieces and devour it at his leisure, returning for others at frequent intervals. I have often watched them while they were making a score of these little journeys. In 1877 this region was overrun with grasshoppers, upon which the red-headed woodpeckers feasted royally while they lasted. I saw the birds out on the prairie, a mile or two from the timber, so intent upon catching the 'hoppers that they scarcely noticed one in passing. Sometimes they would catch a 'hopper on the wing, dodging around in a very lively manner to secure the insect, and again they would hunt for their prey on the ground. The insect secured, the bird would alight on a fence-post and devour it. I have occasionally seen them, attended by their progeny, in the open fields, where the old birds were engaged in catching insects for the clamorous younglings, which had not yet learned to provide for themselves. It would seem that, at the time the young birds require so much food, the old ones would need some readier means of supply than would be afforded by pecking for grubs in decayed timber, or searching for insects on the outside of trees—whether the "creepers" had intruded upon their domain or not. So far as I have been able to observe, the red-headed woodpecker is really a very "versatile bird," evincing a readiness of resource and an easy adaptation to his environment that are truly wonderful.—*Chas. Aldrich, Webster city, Iowa.*

FISH NOTES FROM THE PACIFIC COAST.—Several fine carp were caught recently in Sonoma creek, one of which weighed nearly eight pounds. They are said to bite like a trout and to make a good fight. Young catfish which were placed in Clear lake,

[1]The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

Lake county, last fall, and which at that time measured from one to three inches in length, are found to have grown rapidly; some have been caught within a few weeks that measured ten inches. Sturgeon fishing or spearing is being pursued extensively, as reported, in the Mokelumne river, at Athearn's ford. It is a quite frequent occurrence to capture specimens weighing from fifty to one hundred pounds.

The young trout with which the streams of Santa Cruz county have been stocked are natives, coming from the McCloud river. This species is regarded as the most vigorous, and frequently attains the weight of five pounds. It is said to have a growth of ten inches in one year. It is reported that the Commissioners in charge of the Yo Semite valley have decided to plant the McCloud river trout in the streams of the Yo Semite reservation. The experiments with the brook trout of the Atlantic States in the streams of the coast range, have not been satisfactory; this is owing, quitely likely, to two causes: first, too high a mean temperature in the waters of said streams; and second, through the impurities they contain, which must be especially obnoxious to so dainty a fish during the fall months when the streams are low, muddy and warm, and the water flavored more or less by the bituminous shales through or over which they frequently flow, and out of which ooze numerous small springs, often covered with an oily slime or scum. Experiments with eastern trout are much more likely to meet with success in the loftier regions of the Sierra Nevada, in the clear cold waters of a granitic formation, nearer the line of almost perpetual snow.

Santa Cruz fishermen sometimes catch a few mackerel and shad in the neighboring waters of the bay. The former are a native, the latter an introduced fish, but yet scarce. For some reason the mackerel do not strike in toward the shore to any considerable extent. In consequence of this, the few that are sent to the San Francisco market are sold at fancy prices.

Salmon commenced running in Puget Sound about the 25th of March.—*Robt. E. C. Stearns.*

NOTES ON THE APPLE-WORM.—Mr. J. Savage, of Lawrence, Kan., in a recent number of Colman's *Rural World* remarks upon the freedom of Michigan apples from the work of the apple-worm (*Carpocapsa pomonella*). This same freedom was generally noticed in 1878, not only in Michigan but in many parts of New York, and it doubtless obtained elsewhere. It will be well for us to endeavor to arrive at the reasons. To my mind the following, first stated by me in the New York *Tribune*, may very properly be urged: 1st. The very general failure of the apple crop in 1877, as exemplified in the reports for that year, which we find both in the Proceedings of the Michigan Pomological Society and in those of the American Pomological Society. This failure

was in many localities so nearly total that scarcely any apples were grown, and it follows, as a consequence, that very few codling moths were produced to perpetuate the species the following year. A second reason, so far as Michigan is concerned, may be found in the fact that in no State in the Union have more intelligent and persevering efforts been made to prevent its ravages. Through the columns of the agricultural and horticultural journals as well as in the pages of their pomological transactions, the simple methods of fighting this pest that have been reported and recommended in the Missouri reports have been persistently kept before the people, while Prof. Beal, of the Agricultural College, has, perhaps, done more good than any one else by showing that it cost him no more than four cents per tree to keep the bands around the trunks, changing them every nine days in the warm months, from the first appearance of the worms until the end of August, in an orchard of two hundred and fifty trees. I agree with him when he asserts that "if a man will not take the trouble to keep his fruit from the worms, he deserves to eat wormy apples."

Missouri apple growers should take courage from these facts. Since my connection with the Department of Agriculture there have been sent to me four different kinds of patent bandages to be used as traps for this apple-worm, but I can find no advantage in any of them over the simple paper bandages first recommended by me in 1872, and since very generally employed.—*Prof. C. V. Riley before the Mo. State Hort. Soc.*, 1879.

Does the Snowy Owl Breed in the United States?—The snowy owl (*Nyctea nivea*) is a common winter visitant, near Chicago. It frequents the haunts of rabbits and various members of the grouse tribe. On the borders of Lake Ontario, in the great wooded marshes, these birds find thousands of rabbits roaming in night time in the frozen tracts. They are caught here in large numbers, and the author recalls the capture of fifteen of these during the winter of 1875, near Mexico, New York. The manner in which they are captured is of no little interest. During the day they take to the open lots adjoining the marshes, but in the night ravage the woods. They are seldom known to leave the small area selected for their depredations, unless driven away. In the day area they have but three or four places on which they alight, and when they are disturbed are sure to fly to one or other of these places, often moving in a circuit for hours. A high stake being placed in the center of the open lot, and a small steel-trap placed thereon they will speedily take to the stake in preference to other resorts, and are consequently caught. No bait is placed in the trap, the bird being caught by making simple use of the peculiarity of their habits. Their white plumage gives them the appearance of the snow beneath them, so that they may

dart swiftly on their prey, almost unperceived. There is a matter regarding the snowy owl in which ignorance of their habits or scientific assumption must predominate. The assumption is that they are strictly boreal, or Arctic, in their breeding habits. Many farmers, however, along Lake Ontario assert they are seen there during the entire year, and there is consequently a belief among them that they breed there. In the "North Woods" of New York the author once saw a young snowy owl—not nearly full fledged—shot by a hunter in early spring. The hunter persisted that the bird was one of several young seen by him in proximity to each other. I am not yet prepared to believe that they breed in that latitude, but record the current opinions for the use of any one who may investigate the matter fully.—*W. H. Ballou.*

Double-headed Snakes.—In the Am. Naturalist (Oct., 1878, p. 694), the essay on the Natural History of Guiana (1769) should have been credited to Edward Bancroft whose name stands at the end of the dedication. The monstrous snake of Lake Champlain with two heads side by side seems to be of an unknown species, judging from the doubtful checker-board spots, although it is compared with "the rattle-snake." Here "amphisbœna" is a misnomer, as the name implies the ability to go in both directions (forward and backward), a power possessed by these lacertians, both ends having nearly the same shape.—*S. S. Haldeman.*

Amia calva.—We have received a letter from Jacob Stauffer, of Lancaster, Pa., in which he states that a specimen of *Amia calva* has recently been taken in the Susquehanna river, below Safe Harbor, and is now preserved in the Linnæan Society of Lancaster. This is the first definite account of the existence of this species in the Susquehanna, though as pointed out by Mr. Stauffer, DeKay had suspected it. Mr. Stauffer calls attention to the pouch enclosed between the sub-lingual bone and the throat of this fish, which has been little or not at all noticed by writers.

Habits of Ants.—In the sixth part of Sir John Lubbock's Observations on the habits of Ants, Bees and Wasps, the author shows that the hairs of plants keep insects from climbing up the stalks, as he believes, to prevent them from obtaining access to the flowers, and from robbing them of their honey. He also confirms Denny and Lespes' statement that workers ants are capable of laying eggs, and Forel and Dewitz's discovery that the eggs produce males, stating that he has bred in his nests "a large number of males;" thus, as in bees, the fertile workers can produce males only. That ants may live three or four years, and that in some nests 100,000 individuals may be by no means an unusual number, is also stated. Many facts regarding the recognition of friends are stated, indicating that "ants of the same nest do not recognize one

another by any password. On the other hand, if ants are removed from a nest in the pupa state, tended by strangers and then restored, some at least of their relatives are certainly puzzled, and in many cases doubt their claim to consanguinity. I say some, because while strangers, under the circumstances, would have been immediately attacked, these ants were in every case amicably received by the majority of the colony, and it was sometimes several hours before they came across one who did not recognize them." Lubbock believes that ants produce sounds, and alludes to a letter in *Nature* for December, from Mr. T. S. Tait, who writing from Baroda, says that by means of the microphone "we have been able to hear the roar [sic] of a black ant when attacked by its companion." Lubbock adds that "Prof. Bell most kindly set up for me an extremely sensitive microphone; it was attached to the under side of one of my nests, and though we could distinctly hear the ants walking about, we could not distinguish any other sound. It is, however, far from improbable that ants may produce sounds entirely beyond our range of hearing; indeed it is not impossible that insects may possess senses, or rather sensations, of which we can no more form an idea than we should have been able to conceive red or green if the human race had been blind. The human ear is sensitive to vibrations reaching to 38,000 in a second. The sensation of red is produced when 470 millions of millions of vibrations enter the eye in a similar time; but between these two numbers vibrations produce on us only the sensation of heat; we have no special organs of sense adapted to them. But there is no reason in the nature of things why this should be the case with other animals; and the problematical organs possessed by many of the lower forms favor the suggestion. If any apparatus could be devised by which the number of vibrations produced by any given cause could be lowered so as to be brought within the range of our ears, it is probable that the result would be most interesting."

He also relates an anecdote of the kind treatment, by its fellows, of an ant born without antennæ, adding, "It would have been difficult for any one who witnessed this scene to have denied to this ant the possession of human feelings." On the other hand when an ant is fighting with one of another species, her friends rarely come to her assistance. "They seem generally (unless a regular battle is taking place) to take no interest in the matter, and do not even stop to look on."

Rev. Mr. McCook, of Philadelphia, author of a recent work on the agricultural ant of Texas, states that the mandibles of ants are worn off and become blunted by the labor which they perform. His observations have been confirmed by Mr. E. P. Austin from the examination of the mandibles of nearly a hundred specimens of a ground beetle (*Pasimachus*). Mr. McCook early in July went to Colorado and New Mexico for the purpose of

studying the habits of the mound ant, *Pogonomyrmex occidentalis*, a common and characteristic ant of the Western plains.

A POISONOUS CENTIPEDE.—Last winter I discovered a living *Cermatia forceps* in wrapping paper in my house in Providence, R. I. It is possible that it came in a bundle from Princeton, N. J., and was not a native Rhode Islander. The Cermatia is the most highly developed of all Myriopods; has long sprawling legs, and is greenish-brown in color. It has not before been known to exist north of Philadelphia, and has been found there to be useful in destroying insects and spiders.—*A. S. Packard, Jr.*

ANTHROPOLOGY.[1]

MASTODON, MAMMOTH AND MAN.—The Rev. J. P. Maclean is the author of a small work published in Cincinnati, and entitled "Mastodon, Mammoth and Man." The interest in the public mind concerning the contemporaneity of man with the mastodon and mammoth, and the inaccessibility of reliable information on the subject, induced the author to compile this work. The subject of the great antiquity of these animals is not treated here, having been discussed more fully in the author's work entitled "A Manual of the Antiquity of Man." Part first of the volume now before us relates to the mastodon; part second to the mammoth, and part third to man. In the last chapter are brought together all the instances in which human bones or implements are alleged to have been found in conjunction with remains of the mastodon or the mammoth.

ARCHÆOLOGY AT ST. LOUIS AND PHILADELPHIA.—In the St. Louis loan exhibition the department of archæology was well represented from the collections of Dr. George Engelmann, Messrs. F. M. Perrine, M. S. Mepham, John H. Henderson, J. T. Snyder, F. F. Hilder, C. Croswell, A. J. Conant, Dr. Patrick, J. C. Zimmer and the collection of the St. Louis Academy of Sciences. Those who had the opportunity of enjoying the hospitality of these gentlemen at St. Louis, last summer, will remember the great beauty and value of some of these private collections. It makes one shudder to think how much precious material may be sported away at the mercy of a single friction match. Cannot some plan be devised by which a gentleman of taste and means may indulge in the luxury of a private collection in a fire-proof building, so arranged that the public may enjoy the sight of it without trenching on private hospitality?

On the heels of the foregoing announcement comes a pamphlet from our friend, Mr. E. A. Barber, number five of the Official Bulletin of the International Exhibition, Fairmount Park, Philadelphia, giving a full description of the department of archæology and ethnology, under his charge. "It is proposed also to estab-

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

lish a library of anthropological works which shall be free to all students in this department of science. At an early day classes will be formed which will be instructed in the various branches of the subject by means of a course of lectures, to be delivered by competent teachers and illustrated by means of the collections at hand."

CHUNGKEE STONES AND QUOITS seem to occur on the Susquehanna, in South-eastern Pennsylvania, the former with a shallow concavity on each side, deepening toward the center; the latter roughly lenticular, margin chipped to an edge; in a specimen before me (three and a-half inches in diameter) one side has a *fovea* for the thumb. Dr. Abbott's figure 210 may represent a quoit.—*S. S. Haldeman, Chickies, Pa.*

IRON AXES like figure 31 (AMERICAN NATURALIST, Dec., 1878, p. 785) are regarded as French. They occur in Pennsylvania on the Susquehanna, and are without steel. One before me has on each side the three impressed circlets thus ⁂, their interior shaped like a rude star, and not as in figure 31, which may be erroneous. See *American Antiquarian*, Jan., 1879, p. 170–2.—*S. S. H.*

ANTHROPOLOGICAL NEWS.—In the *Magazine of American History* for April, Dr. Charles Rau gives a letter from Mr. Worsaae, director of the Museum of Northern Antiquities, at Copenhagen, upon the transfer of the Dighton rock to the Society of Northern Antiquaries by Mr. Niels Amzen, and its re-transfer to the Boston committee upon a monument to commemorate the landing of the Northmen in North America.

Dr. Frank L. James, of Osceola, Arkansas, writes to the Smithsonian Institution describing vases with the orifice on the side of the neck, and bearing upon the bottom unmistakable evidence of having been moulded upon a gourd which was subsequently burned out.

Prof. Cleveland Abbe draws attention to an article in the *New England Historical and Genealogical Register*, Jan., 1879, by the Rev. Edmund F. Slafter, on pre-historic copper implements. The communication is in the form of an open letter to the Historical Society of Wisconsin. Mr. Slafter seeks, at first, to show from the cultivation of the savages in other directions that it does not seem to be an act of credulity to believe that the Indians of the early settlers were capable of manufacturing these copper implements by shaping them under the hammer or by casting them in moulds.

The second part of the article consists of testimony drawn from the journals of early European explorers or colonists showing that implements of copper were in use among, or were made by the Indians then inhabiting the country. Jacques Cartier, in

1535, on his second voyage, was informed by his two Indians who were with him that red copper came from Saguenay, meaning the Lake Superior region. He says, "The savages that we had with us told us that here was the beginning of Saguenay, and that the country was inhabited, and that from thence came the red copper which they called *caignetdaze*." Other references to this same *caignetdaze* are given from Cartier, and an extract from Champlain on copper implements. Prof. Abbe asks whether this word *caignetdaze* may have any connection with the origin of the word *Canada*. We have been under the impression that the Iroquois *Kanata* gave rise to the word Canada; but perhaps some of the readers of the NATURALIST can shed some light upon the subject.

Numbers 2, 3 and 4 of *Correspondenz-Blatt* contain a few papers of general interest. In number 2 we have a communication by Dr. von Christ before the Anthropological Society of Munich, upon Schliemann's excavations at Mycenæ, and a prospectus of the forthcoming anthropological exhibition at Moscow. In number 3, Prof. H. Fischer, of Freiburg, gives some further information upon the diffusion of hatchets of nephrite, jadeite and chloromelanite, especially in Europe. Dr. Korbin, of Berlin, contributes to number 4 a paper on new anthropological measuring apparatus and methods. In the same number Mr. Ingvald Undset reviews the anthropological literature of the North.

Mittheilungen der Anthropologischen Gesellschaft in Wien, numbers 10–12 of 1878, and 1–3 of 1879, also furnish original papers of general interest. It will be impossible to give more than the titles of the articles: Prähistorische Eisenschmeltz und Schmiedestätten in Mähren, by Dr. H. Wankel, Vol. VIII, 289; Ueber die Kosmogonie und Anthropogenie des germanischen Mythus, by Dr. M. Much, id., 324; Ueber die angeblich trepanirten Cranien des Beinhauses zu Sedlec in Böhmen, by Dr. Heinrich Wankel, id., 352; Archäologische Beiträge aus dem Osten Europas, by A. F. Teplouchoff, id., 360; Ueber die Wahl der kraniometrischen Ebenen, by Prof. Moriz Benedikt, Vol. IX, 1; Offener Brief an Herrn Prof. Benedikt von Paul Broca, id., 16; Die Ursitze der Gothen, by Dr. Fligier, id., 15; Künstliche Höhlen in Niederösterreich, by Dr. M. Much, id., 18; Germanische Befestigungen des oberen Waagthales in Ungarn, von Julius Neudeck, id., 29.

Archiv für Anthropologie, Vol. XI, part 3, Jan., 1879. Die communale "Zeitehe" und ihre Ueberreste, von M Kulischer; Das Urnenfeld von Maria-Rast, von Graf Gundaker Wurmbrand, pp. 231–280, with tables, IX–XIII; Ueber gewisse Ueberbleibsel embryonaler Formen in der Steissbeingegend beim ungebornen, neugebornen, und erwachsenen Menschen, von A. Ecker, 281–284.

Mittheilungen aus der russischen Literatur über Anthropologie und Archäologie, von Dr. Ludwig Stieda. Thirty titles exam-

ined, pp. 287–353 (best thing in the number, and first rate). Ueber einige neuere Arbeiten über das Gehirn, Prof. Dr. Pansch, in Kiel, 354–365; A review of Poesche's "Die Arier," A. Ecker; Ethnographisches aus der neueren Reiseliteratur, von F. Ralzel; A review of the transactions of learned societies and associations; The Fourth Russian Archæological Congress at Kasan; The British Association; International Congress; American Association. In this number we have the second of the series of catalogues of anthropological museums of Germany in the list of the Anthroplogical Collection of the University of Göttingen, founded by Blumenbach, by Dr. J. W. Spengel; and Catalogue of the Anthropological Collection of the University of Freiburg, by Alexander Ecker. Everything is nicely done in these lands.

M. Emile Cartailhac, the editor of *Matériaux pour l'Histoire de l'Homme*, sends us a pamphlet of 103 pages, entitled "L'Age de Pierre dans Les Souvenirs et Superstitions populaires, par M. Emile Cartailhac, avec 68 gravures et 2 planches dans le texte, Paris. C. Reinwald, 1878. The author has been engaged upon this study for some time past and has contributed several papers bearing thereupon to the *Matériaux*. We give the contents of the seven chapters:

I. La pierre de foudre, le coin du tonnerre.
II. Des haches de pierre transformées en amulettes.
III. Pointes de fleches en silex montées en argent et en or.
IV. Les bijoux et les charmes sous forme de pointes de flèches et de hachettes.
V. Le rôle des silex taillés dans les cérémonies religieuses en Orient et en Occident.
VI. De la transition de l'âge de pierre a l'âge de bronze.
VII. L'âge de pierre et les auteurs classiques de l'antiquité.

The following papers have come to notice since our last issue: The Practice of Medicine and Surgery by the Aboriginal races of the South-west, by Dr. W. J. Hoffman, Philadelphia Reporter, Feb. 22d, 3 pp.——The Ancient Cities of Cibola, Rev. S. Jackson, Rocky Mountain News, Jan.——The Failures and Fallacies of Prehistoric Archæology, Rev. J. A. Waddell, Southern Presbyterian Review, Oct.

GEOLOGY AND PALÆONTOLOGY.

A Decade of Dogs.—The Truckee beds of the White river formation in Oregon have yielded a larger number of species of *Canidæ* than any other American horizon, while representatives of other families of *Carnivora* are much less common. Ten species of dogs have been determined by Prof. Cope, which are referred to five genera, viz: *Enhydrocyon* Cope; *E. stenocephalus* and *E. basilatus*; *Temnocyon* Cope; *T. altigenis* and *T. coryphæus*; *Icticyon* Lund.; *I. crassivultus*; *Canis* L.; *C. geismarianus*; *C. lippincottianus*; *C. cuspigerus*; *C. gregarius*; *Amphicyon* Lart.; *A.* (*?*) *vetus*.

THE CLASSIFICATION OF ROCKS.—Mr. M. E. Wadsworth publishes in the Bulletin of the Museum of Comparative Zoölogy of Cambridge[1] an abstract of a thesis on the classification of rocks, from which we extract the following: "No natural distinction can be drawn between rocks of the Tertiary and Pre-Tertiary ages, since the glass and fluidal inclusions, crystalline texture, and the various other characters fail, exactly where they are most needed, to divide the rocks into older and younger, as is done by the majority of lithologists.

"The writer believes that rocks should be studied, by beginning with their most compact or glassy state, and by then tracing them through to the most crystalline form, following every alteration, whether it be chemical or mechanical. Every rock that can be traced in this way forms a distinct species, whatever may be its state,—whether amorphous, glassy, crystalline, fragmental, tufaceous, or otherwise,—and whatever may be its age. The modifications, if of sufficient importance, form varieties simply, which should be included under the specific name. A natural classification of rocks must be empirical, and must be based on the rock as a whole, while a natural mineralogical classification is an impossibility, as it is based on part of the characters only.

"If we except the veinstones and the majority of those rocks that are composed of one mineral, the species of rock forming the crust of the globe are very few. Believing that this earth is a cooling globe, all manifestations of internal heat giving rise to rocks (the only thing with which we are at present concerned) are here termed volcanic, and all such products are styled volcanic rocks. The testimony of the rocks is that all sedimentary forms came primarily from volcanic ones, volcanic energy having been more active than now in the past ages of the globe. This derivation is consonant with that which we see taking place at the present time, and agrees with the law of dissipation of energy; while the reverse view, at present popular,—that eruptive rocks were derived from sedimentary ones,—is contrary to the positive testimony of the rocks themselves, to the facts that are observed in nature, and to physical laws.

"Taking the consolidation of any rock as its initial point, the minerals and rock fragments contained therein fall naturally into three classes: 1. Minerals and fragments of prior origin; 2. The products of that consolidation; 3. The products of alteration and infiltration.

"These three classes are most marked in the volcanic rocks, as is natural; the first two predominating in the younger and least altered, the latter in the older and more altered ones, while the first and third classes predominate in sedimentary rocks. These alterations apparently take place through the agency of the ordi-

[1] Vol. V., No. 13, 1879.

nary percolating waters, which are not necessarily hot. The minerals and fragments of the first class, I find, fall into two divisions in the volcanic rocks: 1. Those that are characteristic of the rock species, and which were probably derived from the refusion of this species, that had crystallized at the depth at which it was prior to the eruption; 2. Those that are accidental, probably caught in the passage upward or during the outflow. Similar divisions are found, to a greater or less extent, in the sedimentary rocks, according as they were derived from one or more rocks, and also according to the preponderance of different rock fragments and minerals in them. Details of these occurrences will be given in the final publication.

"Believing that new names should not be employed, except in cases of absolute necessity for filling gaps in the classification, the effort has been made to retain all the old names that are necessary, in their most general use, and to reject all needless ones, that can be so dealt with.

"Starting with the basic rocks, I shall pass from the glassy states to the most crystalline, from the least altered to the most altered, and from the massive to the clastic, keeping on a similar range of chemical composition, and tracing the various gradations step by step. I shall also, in like manner, trace the gradations from the basic to the more acidic rocks, showing the gradual changes that exist in that direction as well. Since, owing to the necessities of the case, both in the use of these observations in a thesis and in giving a post-graduate course in lithology in this Museum, my work was made public before it was entirely completed, it has been deemed necessary to publish this abstract in advance. Several matters of detail yet remain to be worked out, which may modify some of the general views. All that is liable to be so modified must, therefore, be withheld for the present."

GEOLOGICAL AND PALÆONTOLOGICAL NEWS.—M. Mariano Barcena continues his researches on the geology and palæontology of Mexico in the Anales del Museo Nacional de Mexico.—Dr. Lydekker publishes descriptions of extinct reptiles of India in the memoirs of the Geological Survey of India. He describes *Sauropterygia*, *Crocodilia*, *Theromorpha* and *Dinosauria;* including *Dicynodon*, *Titanosaurus indicus*, *Plesiosaurus*, etc. Dr. Lydekker in another paper describes an extinct *Quadrumane* from the Sewaliks of Punjaub, of rather larger size than the orang outang, which he names *Palæopithecus sivalensis.*——Mr. C. D. Walcott of Albany, N. Y., continues his researches on the structure of the *Trilobita*, and gives us an account of the metamorphoses of *Triarthrus beckii* of the Trenton limestone. He also discusses the Utica slate and its fossils.——The Rev. W. H. Barris publishes in the proceedings of the Davenport Academy of Sciences an account of the local geology of Davenport, Iowa, and describes some new Corniferous fossils.

GEOGRAPHY AND TRAVELS.[1]

THE SLAVE TRADE IN CENTRAL AFRICA.—While the transportation of slaves from the coast to Zanzibar has been almost entirely stopped by the exertions of the British navy, slaves in large numbers are still brought to the coast mostly from the tribes living to the east of Lake Nyassa. Huge caravans are reported passing north along the coast, and probably these slaves are embarked from points far to the north in the Somali country. Others are smuggled into dhows by twos and threes at the coast towns, and so escape detection. The presence of Europeans even singly and unarmed in the interior has done much to discourage the kidnapping of the natives. A missionary in East Africa, writing to the London *Times*, quotes a chief as saying: "We don't want to sell slaves if we can get our wants supplied by other means. You have come here with cloth, and beads, and brass wire, things which we formerly bought with slaves, but now we can sell our grain, our rice, our beans, our eggs, our fowls for them, and we are well satisfied. As to gunpowder, you won't bring that and sell it to us, but we are safe now that you live here, people won't come to sell us into slavery; we are, like you, living in peace, and so we no longer want gunpowder."

The trade is also being stealthily carried on in the Red sea. An interesting letter to the *Times*, from Alexandria, gives an account of Col. Gordon's successful efforts to destroy this traffic in the Soudan. His rule extends from the first cataract of the Nile to the equatorial lakes, from the western frontier of Darfur to Cape Gardafui and the towns of Berbera and Zeyla on the Indian ocean.

Having succeeded in the first two years of his government in establishing order throughout his dominions, he next turned his attention to breaking up the trade in slaves, prevailing chiefly between tenth and fifth degrees of north latitude, and especially in the region described by Schweinfurth as forming the water-shed of the Bahr Gazel—a vast alluvial land formerly rich in population, corn and cattle, but now turned into "barren wildernesses." In 1871 Dr. Schweinfurth estimated that 2000 traders were annually obtaining 15,000 slaves from one set of tribes alone. In the last half of 1878, Col. Gordon arrested forty-two caravans and liberated the slaves. Finally he despatched Capt. Gessi with 3000 men against Suleyman, the principal slave dealer, who had broken out into open rebellion.

In an attack made by Suleyman, with 11,000 men, on Capt. Gessi's entrenched position on the 27th of December last, the rebels were totally defeated, leaving 1087 dead on the field, and on the following day 5000 deserters came over to Gessi's camp. "The enemy retired but Gessi followed them up and killed ten chiefs and over 2000 of his men, and is still in pursuit." The

[1] Edited by ELLIS H. YARNALL, Philadelphia.

capture of all the positions which at present serve as so many slave trade centers is considered now certain. The root of all the nefarious traffic will thus be destroyed, and the destruction of these merchants means the end of the trade.

Owing to the many natural impediments, Col. Gordon is convinced that the commercial highway of Europe to the rich equatorial districts of Africa does not lie along the Nile but by way of the Indian ocean.

MICROSCOPY.[1]

PURITY OF LAKE WATER.—In a Report on Microscopical Examinations of the water from Lake Michigan, as delivered from the city hydrants in Chicago, by Mr. B. W. Thomas, in the Third Annual Report of the Board of Public Works of that city, it is argued that the water for supplying the hydrants is taken from too near the shore, although pumped from cribs which are two miles out in the lake. After describing the method of obtaining organisms by filtering the water through a piece of cotton cloth tied in the form of a bag over the end of a faucet, and enumerating the harmless vegetable and animal forms that constitute nearly all of the filtrate obtained, the paper concludes as follows:

"But occasionally we find what is not quite so acceptable, for instance a *Tardigrada* (*Macrobiotus hufelandi*), a *Paramecium*, an *Anguillula fluviatilis*, a *Hydrachna*, a family of lively *Vorticellæ*, etc., that have evidently been carried out to the lake crib by the lake or river currents from the breakwater or shore, where, at certain seasons, they are found in great numbers, especially near the river or sewer outlets. Storms scatter these organisms in the waters of the lake for some considerable distance from the shore, and when once taken into the tunnels and mains they continue to multiply, and a few of them can be found in the water supply at almost all seasons of the year.

"Careful observation by different microscopists does not leave a reasonable doubt that nearly all of the impurities, properly so called, found in the water as drawn from the hydrants comes directly or indirectly from the sewage and river water that is discharged into the lake. So long ago as December, 1871, Prof. H. H. Babcock, in an article in *The Lens*, "on the effect of the reversal of the current of the Chicago river on the hydrant water," said that the microscopic examinations by himself and others interested in the same study "are sufficient to determine the fact that the reversal of the course of the Chicago river has decidedly increased the purity of the hydrant water by removing a large part of the organisms it had previously contained, and I have no doubt that the sanitary condition of the city—so marked at the time—was promoted by this change in the character of the water supply.

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

"Evidence in corroboration of statements like this is so abundant and easily obtained that it cannot be successfully refuted, and the only conclusion that I can arrive at is, that the purity of the hydrant water can only be maintained by preventing the discharge of all impurities into the lake, or by extending the tunnels a sufficient distance from the shore to be beyond their influence."

MICROMETRIC RULING.—Several observers now claim to have resolved the bands of lines 120,000 to the inch, by both Rogers and Fasoldt. Prof. Rogers' recent work has been devoted to the methods and instruments for obtaining aliquot parts of the standard yard and metre with great precision, rather than to the production of extremely close rulings. Mr. Fasoldt is now ruling twelve-band plates, with bands claiming from 12,500 to 150,000 lines to the inch.

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SCIENTIFIC NEWS.

— Congress, at the recent session, transferred the cotton worm investigation from the Department of Agriculture to the Department of the Interior, adding it to the work of the U. S. Entomological Commission, Prof. C. V. Riley, the chairman of the Commission, having resigned his position as Entomologist to the Agricultural Department, owing to the inability of the present Commissioner to appreciate scientific energy and methods, and to give due credit for them, in a department where they are needed just at present more than in any other. Prof. Riley, who has the investigation of the cotton worm in special charge, is now in Texas, with the agent of the Commission, Mr. Schwartz, and has already determined that the cotton worm hybernates in the moth state in the Cotton States; that the worms in Texas appear as early as the middle of May of nearly full size, nearly six weeks before they had ever been seen by the planter; experiments will also be made as to the best means of destroying the worm, on a large scale. Prof. A. S. Packard, Jr., is spending the summer in Colorado, Wyoming, Utah and Eastern Idaho, investigating the present status in the permanent breeding places of the Rocky Mountain locust, and Prof. Cyrus Thomas is to make a trip to Dakota for the same purpose. A number of agents are also at work in the West. The Commission also designs, incidentally to this investigation, working up the Chinch bug, Hessian fly and Canker worms, and has sent out circulars asking for local information as to the habits and statistics of losses. Entomologists are desired to coöperate in the work this season.

— Mr. King, director of the U. S. National Geological Survey, has secured the passage of a bill through Congress authorizing the extension of the operations of the survey over the several States of the Union. It is said that he proposes doing some

work in Tennessee the present year. This plan of Director King appears to us to be of doubtful propriety, and in fact only defensible on the supposition that Congress will treble its usual appropriation for the survey. Moreover, the people and legislatures of the several States should by no means be relieved of the responsibility of conducting their own geological surveys at their own expense. Mr. King also announces that the work of the survey will be restricted, at present, to mining and petrographic geology. This is in the line of contraction already anticipated by this Journal.

— We have received the announcement and description of the zoölogical laboratory of the Faculty of Sciences of the Catholic University of Lyons extracted from *The Contemporain* of March. It includes laboratories of anatomy, physiology, microscopy, drawing; also museum, aquarium, lecture room, etc. The appliances appear to be excellent.

— Prof. Harrison Allen has been elected to the chair of physiology in the University of Pennsylvania, and has resigned the professorship of zoölogy of the summer course. To this position Dr. A. J. Parker has been elected.

— Prof. H. C. Wood, of the University of Pennsylvania, is now engaged in physiological studies in Vienna, and Prof. Frances Emily White, of the Women's Medical College, of Philadelphia, is in London on a similar errand.

— Prof. W. M. Fontaine has been elected to the chair of natural history and botany in the University of Virginia.

— The *Penn Monthly* publishes in its July number an interesting article, by Edward Howland, on the language of animals.

— We learn that O. A. Derby is meeting with good success in Brazil, being in charge of the extensive geological collections made by the late Prof. C. F. Hartt. Mr. Derby is supported by the government, so that there are hopes that all the results of the work of the late Geological Commission will yet be made available to science.

— The Report of the Fruit Growers' Association of the Province of Ontario, for 1878, has just been received. It contains the Annual Report of the Entomological Society of the Province of Ontario, and papers relating to injurious insects, of considerable local interest.

— A general work on the Natural History of the Batrachians, by Dr. Friedr. Knauer, of Vienna, is announced. It will be in octavo, with 120 illustrations, 4 maps and 2 plates.

— H. Holt & Co., New York, have in press a Zoölogy for Colleges and High Schools, by A. S. Packard, Jr., to be published in September.

— The Massachusetts Board of Health have undertaken to make an investigation into the laws of the hereditary transmission of disease, and have issued a circular with a blank, which has been prepared for the collection of statistics, upon which can be based an investigation of the laws governing the inheritance of pathological conditions, abnormal characteristics of all kinds, and any family characteristics or peculiarities sufficiently marked to have been made the subject of observation. Those who may be interested in helping in the matter should apply to Prof. Alpheus Hyatt, Boston Society of Natural History, Boston, Mass., for the circular and blank, and return them when answered to the same address.

— The Summer School of the Johns Hopkins University will be located, the present summer, near the mouth of Chesapeake bay. Prof. Baird, of the Fish Commission, has given it the use of a steamer for dredging purposes, and the students will board on barges anchored in the bay. We have received, from time to time, Directions for Laboratory Work of the Teachers' Class in Elementary Zoölogy at the University. They are prepared by Prof. W. K. Brooks, on the general plan of Huxley and Martin's Biology, and seem to serve the purpose of giving the student a thorough, well-grounded knowledge of structural zoölogy, and we doubt if any other college would show more care and thoroughness in teaching. A few copies are for sale at the University.

— The great work of G. W. Tryon, Jr., on the Mollusca, has reached the third part of the *Cephalopoda.*

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences, May 19.—Papers were read by Dr. R. P. Stevens on the corrugation of peat-marsh by pressure, and by S. W. Ford on the composition of the primordial fauna.

May 26.—Prof. J. S. Newberry made a communication on the former Cretaceous and Tertiary margin of the continent east of New York. Prof. D. S. Martin noticed the occurrence of Devonian beds at Monroe, Orange county New York.

Middlesex Scientific Field Club, Malden, Mass., June 4.—Frank S. Collins read a paper on the best methods of gathering and preserving sea weeds. L. L. Dame mentioned the occurrence of *Clematis* (Atragene) *verticillaris* in Medford. This plant has not before been recorded from Middlesex county. Miss Martha Silvester made some remarks on the genus Viola. A paper on the importance of visiting the large museums was presented by

M. A. Hardaker. She advocated the use of these museums, as the members would there learn by illustration the system used in Zoölogy, etc. H. L. Moody presented a list of eighteen species and one variety of Solidago found in Malden and vicinity, and made some remarks on doubtful species. Mr. Moody also mentioned that he had bred *Capnochroa fuliginosa* from the larva. The larva does not differ from the usual Cistelidous type. He had attempted to breed *Capnia pygmara* and a species of *Gordius* from eggs. The young Capnia were destroyed by other larvæ when of an age to be readily seen by the unaided eye. The Gordius larvæ are still alive.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

American Journal of Science and Arts—June. The forests of Central Nevada, with some remarks on those of the adjacent regions, by C. S. Sargent. Notice of recent additions to the marine fauna of North America, No. 5, by A. E. Verrill. Polydactyle horses, recent and extinct, by O. C. Marsh.

The Journal of Conchology—May. Notes on the habits and distribution of certain West Indian Pulmonifera, by J. S. Gibbons.

Annales des Sciences Naturelles, VIII, Nos. 2, 3.—1878. Organization and development of some endoparasitic marine Trematodes, by M. Villot. Migrations and metamorphoses of the Tæniæ of moles (*Sorex*), by M. Villot. Dredgings off Marseilles, by M. Marion.

Siebold und Kölliker's Zeitschrift für wissenschaftliche Zoologie.—May 26. Studies on the development of Sponges, by E. Metschnikoff. On the means by which mammals adhere and move upwards by atmospheric pressure on more or less perpendicular surfaces, by O. Monike. Contribution to a knowledge of the reproductive organs of free-living Copepoda, by A. Gruber, Researches on the finer structure of the digestive canal of *Emys europæa*, by J. Machate.

Psyche.—May, June. The anatomy of *Amblychila cylindriformis*, by C. F. Gissler.

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Errata.—Page 141, in *third* line of second paragraph, before the word "during" and after the word "well," in the *ninth* line, insert "quotation marks."
Page 142, *sixth* line from bottom of page, read "through being more," instead of "though more."
Page 147, *fourth* line from bottom of page, omit the word "specific."
Page 154, second paragraph, *last* word in *last* line, read "west" instead of "east."
Page 411, first paragraph *second* line, the word "south" should follow after "neighborhood."
Page 415, second paragraph *fourth* line, insert the word "an" before the word "increased."
Page 416, first paragraph *fifth* line from bottom, for "twist" read "twists."
Page 418, under the figure, for "Darley" read "Barley."
Page 419, second paragraph *fifth* line from bottom, after the word "spikelet" in the parenthesis, add "and fifteen to thirty spikelets in a single head."